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No. 2

EFFECTS OF CARBON MONOXID UPON THE EYE.

W. H. WILMER, M.D., L.L.D.

WASHINGTON, D. C.

This paper gives a general survey of the subject and includes a graphic description of the subjective and general nutritional effects of carbon monoxid poisoning, by one of the victims; and incidentally throws light on the origin of a story of a haunted house. It gives an account of the ocular symptoms of such poisoning, revealing a distinct tendency of the poison to cause neuritis and especially to affect the optic nerve.

Read by invitation before the Ophthalmic Section of the College of Physicians, Philadelphia, Pa., October 21, 1920. For discussion see p. 127.

The exposure of the human organism to the ravages of carbon monoxid, is a constantly increasing menace in all walks of life. The fact that the details in regard to eye involvements are very meager, despite the voluminous literature upon its general effects, has led the writer to present, in this great ophthalmologic centre, a consideration of the injurious effects of this gas upon certain ocular tissues.

While the ophthalmologist is chiefly interested, clinically speaking, in the chronic form of carbon monoxid poisoning, it will be necessary to consider, in a general way, the universality of this gas; the insidious somatic effects with their sequelae; its combinations in the blood, and the well recognized pathologic changes found in fatal cases, in order that there may be a full appreciation of the action upon the central nervous apparatus and, thru this system, upon the eye itself.

Carbon monoxid has existed in nature, in varying amounts, ever since the first occurrence of the phenomenon of combustion in the presence of a limited amount of oxygen. It formed a part of volcanic gases, and the "Blacksmith Gods" of the old mythology produced it in their forges. In ancient Rome, he who felt that there was "no way except the Bridge of Death" sought its aid in the fumes of charcoal. In modern France, the favorite method of committing suicide is by the inhalation of this gas.

The first production by artificial means was in 1776 when Lassone obtained this gas by heating zinc oxide with carbon.

The gas "is formed wherever combustion of carbon-containing material occurs," tho the proportion of carbon monoxid varies from the almost negligible amount produced by a burning straw to the 30% contained in carburetted water gas. Cogshall estimates that the gasoline torch produces 7% to 10%, while Gardner says that he has found carbon oxid in the vapors of drying paint. According to Apfelbach, the blast in the steel industry produces about 26% of carbon oxid; producer 23%; exhaust from gas engine 9.3%; and he quotes the analyses made by Schumacker of the air of five motor garages in which the average of the five was 0.042%.

Henderson gives the percentage of carbon monoxid in coal gas as 6% to 8%. He also says that carbon monoxid "is the chief constituent of illuminating gas, and to illuminating gas in turn may be traced an unfortunately large number of fatalities in American cities." Seventy-eight per cent of the gas used in the United States is water gas. In a large majority of gas works no attempt is made to remove the carbon monoxid. Ordinarily tests are made for only sulphureted hydrogen.

To these figures must be added the large increase (60% since 1914) in the use of gas for cooking and heating pur-

poses—induced by the great difficulty in getting coal. Apfelbach mentions thirty-one industries in which carbon monoxid poisoning has been observed, and he says in regard to coal gas, producer gas, water gas, furnace gas, etc., "It should be constantly kept in mind that they all contain carbon oxid in varying quantities, and that it has been fairly well established that carbon oxid is the toxic agent in all these cases"; "that the toxicity will vary because of the differences of carbon oxid contents"; and "that gases containing carbon oxid cause more industrial sickness and deaths than the other gases referred to."

In addition to the production of carbonic oxid in buildings, mines, etc., there is a constant pouring out of this gas from the exhaust of automobiles, particularly in the traffic tunnels. Henderson estimates that "there are more than six million automobiles in the United States, not to mention trucks"—all adding their quota to the pollution of the atmosphere. He further states that it is fatal to man to breathe for an hour air that is normal in other respects, but which contains as much as 0.4% of carbon monoxid.

The gas is recognizable by the "lambent blue flame" that appears whenever fresh coal is put upon the cheerful open fire. But by itself, it is colorless, odorless, tasteless, nonirritating, tho none the less persistent and penetrating. The ordinary war gas mask gave no protection against this gas. It was not until 1918 that the discovery of the absorbent qualities of the oxides of various metals, manganese, copper, etc., made possible the protection of persons exposed to the fumes—following mine explosions, etc. From the clinical standpoint, the gas enters the system only by means of respiration, so that unless it is associated with some evil smelling gas, the victims become helpless before its presence is suspected. Fortunately, newspaper accounts of the fatal results of this gas in closed garages, from the instantaneous gas heater (frequently in the bath room) and from the com-

mon stove, help to warn the public of the danger.

While the tragic results of acute carbon monoxid poisoning always arouse much interest, it is a fact that outside of the industrial centres, very little attention has been paid to the headaches, anemia, gastric disturbances and psychic effects that are caused by chronic poisoning by carbon monoxid from the old fashioned latrobes, hot air furnaces, etc. Yarrow says: "I have made a careful investigation of leaky gas fixtures, and have observed that it is the exception rather than the rule to find them perfect in our houses."

McGurn says: "In all probability there is no better known chemical substance, with which a high percentage of our urban and suburban population is brought into such frequent contact, that has attracted so little attention and yet is so capable of inducing such insidious and wide-spread destruction of health as carbon monoxid gas."

In the autumn of 1917, the writer, together with other Army officers, had offices over a garage. Dull headaches, a slight feeling of subnausea, and general listlessness became common occurrences with many of the office personnel as the day advanced; but the symptoms passed away upon getting out into the fresh air. Many aviators complained of nausea following a whiff of the gases from the exhaust of the motor when flying at high altitudes. This is especially apt to occur when the exhaust escape pipe of the motor ends in front of the pilot's seat. The amount of carbon monoxid inhaled at ordinary elevations is negligible, but a very minute quantity of this gas is sufficient to cause symptoms at an elevation of fifteen thousand feet, when the system is already suffering from oxygen want. This gas will also have its influence upon reducing the strength and power of coordination of the ocular muscles which are so important to good flying.

Surgeon General Stokes, U. S. N., found that a great many of the so-called "heat prostrations" in the stoke-rooms are due to carbon monoxid. It is quite possible that this gas is

responsible for the ocular illusions that occur in coal mines. The writer has been told by one experienced in mines that when a miner sees the "old gray mare" he is immediately taken up to the fresh air.

The susceptibility to the toxic influence of this gas varies greatly with individuals and in certain persons there are distinct adaptive changes (as occurs in oxygen want) which enable the individual to further resist the toxic influence. However, it is certain that distinct toxic symptoms will be felt by practically every individual when the percentage of this gas in the atmosphere reaches the point of 0.05%. In cases of "gassing," the subject is rendered unconscious at practically the first inspiration. McGurn says: "It is a fact that repeated inhalations of very minute quantities of carbon monoxid are far more dangerous to the future health of the individual than one exposure where the patient is rendered unconscious."

In chronic cases, where small doses are inhaled intermittently over a long period of time, the more common symptoms are headaches, vertigo, tinnitus aurium, flashes of light before the eyes, weakness or absence of tendon and pupillary reflexes, nausea, pain in the epigastric region, palpitation, languor, muscular weakness and lack of coordination, convulsive movements, mental disturbances, hallucinations of sight and hearing. Anemia is not always present. In fact, there are at certain stages polycythemia.

McGurn says: "On investigation it was found that these gases are capable not only of producing many diseases and conditions peculiar to themselves, but also of simulating nearly every disease known to modern neuro-pathology, as well as many of the so-called 'idiopathic' and 'functional' disorders." Yarrow has pointed out the possibility of confounding chronic carbon monoxid poisoning with various other conditions and intoxications. Among the sequelae of carbon monoxid poisoning are (according to Apfelbach) (1) pneumonia, (2) psychoses, (3) paralyzes, (4) skin eruptions, and (5) gan-

grene. But there is no mention of the resulting eye lesions.

In the article upon Toxic Amblyopia in the American Encyclopedia of Ophthalmology, the classification of de Schweinitz is given, which puts carbon monoxid under Group II—"Drugs and chemical compounds which in full or toxic doses depress the cerebro-spinal axis or the peripheral nerves." This paper states that: "Intoxication from poisonous combustion products, especially from carbon monoxid and carbon dioxid, as well as from hydrocarbons and other compounds in illuminating gas, is occasionally accompanied by ocular symptoms."

The following are some of the ocular sequelae of carbon monoxid poisoning that have been noted by different authors: H. Knapp; paralysis of several ocular muscles after exposure to the fumes of a stove. Illing; cases of homonymous hemianopsia. Emmert; case of paralysis of third nerve of left eye, associated with trigeminus and facial paralysis. Becker; cases of retinal hemorrhages and congestion of retinal veins. Henderson says: "In more severe cases the patients recover only with the loss, partial or complete, of vision, power of speech, or with some other nervous defect." Edsall says: "Ocular disorders are not very common; these may be partial or complete blindness of varying duration, with or without ophthalmoscopic changes, xanthopsia, nystagmus, and paralysis of the eye muscles, and there have been repeated instances of complete ophthalmoplegia with marked protrusion of the eyeballs." Apfelbach says: "Rare signs are nystagmus and strabismus...hemorrhages in the sclera and conjunctiva...and diplopia." de Schweinitz quotes Schmitz who describes the following results of carbon oxid: "Contraction of the visual fields, partial color blindness, venous hyperemia in the retina and contracted arteries." Many authors mention inequality of the pupils. McGurn gives a list of 105 varying pathologic conditions known to have been caused by carbon monoxid intoxication. Among them

are the following eye lesions: "Central and marginal scotomata of the optic discs"; "color blindness, transitory"; "diplopias"; "engorgement of retinal vessels"; "impairment of pupillary light reflexes"; "impairment of vision (toxic amblyopia)"; "irregular pupils"; "narrowing of the fields of vision"; "nystagmus"; "edema of optic discs"; "sectional blanching of optic discs"; "optic nerve atrophy (secondary)"; "unequal pupils." Nearly all of these conditions were "seen in cases of multiple sclerosis caused by chronic carbon monoxid inhalation in furnace gas."

There is a wide difference of opinion concerning the state in which carbon monoxid exists in the blood of those poisoned by it, and its mode of action upon the body tissues. Haldane, Henderson and others believe that it "acts as a poison solely by its ability to prevent the normal supply of oxygen from reaching the tissues, and thereby the normal metabolism of the body cells." Henderson says: "It resembles oxygen but the avidity with which it combines with hemoglobin is three hundred times greater than oxygen. It kills because it reduces the oxygen-carrying power of the blood and not because it forms a permanent compound with hemoglobin." He believes that access to fresh air causes a speedy disassociation of the carbon compound. On the other hand, many close observers feel that the compound is stable and that it has a direct action upon the delicate nerve structure of the body. Yarrow says: "Carbon monoxid, as is well known, forms a very stable combination (chemic) with hemoglobin, so that blood once impregnated with the deadly gas loses its power as an oxygen carrier to the tissues of the body." According to Rand, "If a considerable portion of the blood becomes saturated with this gas death is inevitable not by suffocation, as commonly imagined, but by carbon monoxid poisoning." McGurn says: "The writer wishes to express the opinion that CO is a chemical substance capable of a peculiar, selective affinity; that enters into a more or less fixed combination

with the hemoglobin of undiluted blood and yet possesses a stronger avidity for certain nerve elements that are not found in other structures of the body; also that when carbon monoxid pervades the general circulation, it is *slowly liberated* from its hemoglobin combination and reabsorbed by receptive brain and nerve tissues so that irritative and permanent degenerative changes often result; and that when such irritations and degenerations of the central or peripheral nervous systems are once established, an infinitely small quantity of this gas (one to two hundred thousand) is capable of aggravating and hastening the retrogressive changes which it has already produced." Apfelmach says: "The CO rapidly united with the hemoglobin, replacing the oxygen and forming a very stable compound known as carboxy-hemoglobin."

Whatever the difference of opinion concerning the mode of action of this poison upon the central organs, all are agreed upon the very definite lesions that have been observed in fatal cases. Munroe says: "The effect is to produce intense congestion of vital organs, especially in the brain, usually accompanied by small hemorrhages." Apfelmach says: CO causes a rapid degeneration of various organs...Autopsy on cases from psychoses of CO gas shows a predilection for degenerations, thrombosis, encephalitis in the lenticular nucleus and optic thalamus. It is held that the encephalitis and hemorrhages, sometimes observed in gas autopsies, are due to the rapid fatty degeneration which occurs in the vessel walls." Concerning the changes in the nervous system in these cases, in addition to conditions already mentioned, Brown states that there were "hemorrhages in the pia of the brain and cord, bloodless patches with softening in the cord and fatty degeneration of the endothelium of the small vessels of the central nervous system, chromalytic and atrophic changes in the large motor cells of the cord." He assumes "an interference with the nutrition of the neurons which regulate the function of the nerves."

CASES

The following instance of the chronic carbon monoxid poisoning of an entire family is given in detail from the account that Mrs. H. wrote while the occurrences were fresh in her mind. This recital is of interest because it gives a very intelligent account of the physical and psychic effects of the gas, and also because the writer has been able to follow the case of one of the children, B., who as a result of this poisoning has suffered from the long continued effects of an optic neuritis.

"Near the end of October, 1912, our town house was burned. Therefore it became necessary for us to hire a furnished house for the winter. As it was November, most of the desirable ones were taken, and we had great difficulty in finding one with a sufficient number of bedrooms. Finally we succeeded in finding one vacant.

It was a large, rambling, high-studded house, built about 1870, and much out of repair. It had not been occupied by the owners for the past ten years, tho occasionally it had been rented for the winter. The house was situated on a sunny street, and altho the sun bathed the outside of the house, it rarely seemed to penetrate thru the tall and narrow windows. All the floors and stairways were heavily carpeted. Absolute silence reigned thru the house, not a foot-fall could be heard. There was no electricity, the house being lighted thruout by gas.

On November 15th we moved into the house. The children were not to come for a couple of days, until we had become somewhat settled. The second day we were in the house the furnace broke down, and new parts had to be made in Syracuse. It was a very old furnace, built thirty years or more ago, a combination of hot air and steam, with a boiler suspended over the fire. While waiting for the new boiler to be made, only part of the furnace could be used, not enough to heat the whole house, so we decided to have the children stay away for ten days longer.

G. and I had not been in the house more than a couple of days when we felt very depressed. The house was over-

poweringly quiet. The servants walked about on thickly carpeted floors so quietly that I could not even hear them at their work.

One morning I heard footsteps in the room over my head. I hurried up the stairs. To my surprise the room was empty. I passed into the next room, and then into all the rooms on that floor, and then to the floor above, to find that I was the only person in that part of the house.

After November 25th the furnace was temporarily repaired and we sent for the children. We felt more cheerful after they arrived, the house seemed less big and solitary. Many mornings, when going down stairs or thru the halls, I would notice an odor of gas. Upon investigating the different gas fixtures I would find them in proper condition.

I had not been in the house more than a couple of weeks when I began to have severe headaches and to feel weak and tired. I took iron pills three times a day and spent a couple of hours each afternoon in my room, lying down and resting, a rather discouraging process, as after resting my headache was always worse than it had been before.

It had always been G.'s habit at night before going to bed, to sit in the dining-room and eat some fruit. In this house when seated at night at the table with his back to the hall, he invariably felt as if someone was behind him, watching him. He therefore turned his chair, to be able to watch what was going on in the hall.

The children grew pale and listless and lost their appetites. The playroom at the top of the house they deserted. In spite of their rockinghorse and toys being there, they begged to be allowed to play and have their lessons in their bedroom.

I grew more tired and indifferent to everything, and also felt very cold in the evenings, and wore shawls and scarfs most of the time. The children seemed so poorly and I was so tired, I took them away the day after Christmas, for the holidays.

While we were away, G. was frequently disturbed at night. Several times he was awakened by a bell ringing, but on going to the front and back doors, he could find no one at either. Also several times he was awakened by what he

thought was the telephone bell. One night he was roused by hearing the fire department dashing up the street and coming to a stop nearby. He hurried to the window, and found the street quiet and deserted.

Soon after the New Year, the children

replied; but as I grew more wide awake I realized that it could not be any one of the doors of the room as they were tightly closed. Another time, a little before daylight, I was awakened by heavy footsteps going down a staircase behind the wall at the head of my bed. Then a

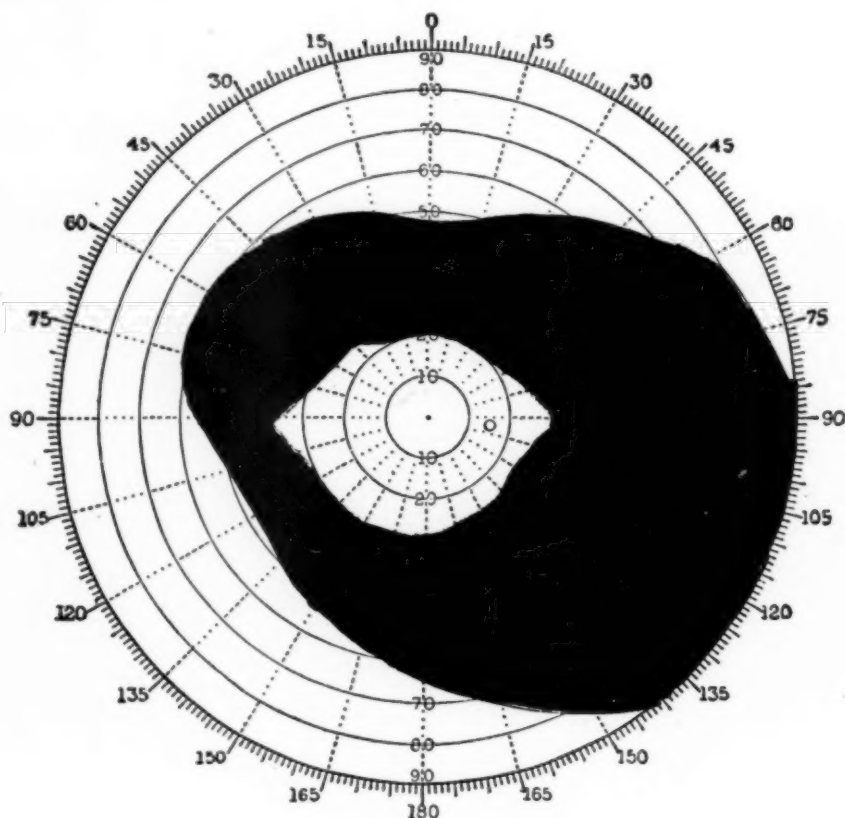


Fig. 1.—Form field of right eye, 1917, Jan. 5. Case 1.

and I, with the nurses, returned to the house. We all felt better for our change and returned quite glad to settle down again. Soon, however, the gloom of the house began to cast a shadow over us once more. The children grew paler and had heavy colds. When out of doors their colds grew less and they seemed better. My headaches returned, and I frequently felt as if a string had been tied tightly around my left arm. One night I was awakened by a heavy door slamming once, quite near me. It woke G., too, and he said to me, "What was that?" "Only the door of the room," I

number of crashes down stairs, as if several pots and pans had been hit together or against the kitchen stove. Soon I realized that there was no staircase behind the wall, only the thickly carpeted front stairs on which no footsteps could be heard. Also that it would be impossible, in my room, to hear any sounds from the kitchen, no matter how loud.

On one occasion, in the middle of the morning, as I passed from the drawing-room into the dining-room, I was surprised to see at the further end of the dining-room, coming towards me, a strange woman, dark haired and dressed

in black. As I walked steadily on into the dining-room to meet her, she disappeared, and in her place I saw a reflection of myself in the mirror, dressed in a light silk waist. I laughed at myself, and wondered how the lights and mirrors could have played me such a trick. This

And so on he talked, insisting that he had been called, and for me to explain who it had been.

The days went on, and the children grew paler and more listless. Some days, as their colds seemed worse, I kept them in bed. Then again, as there did not

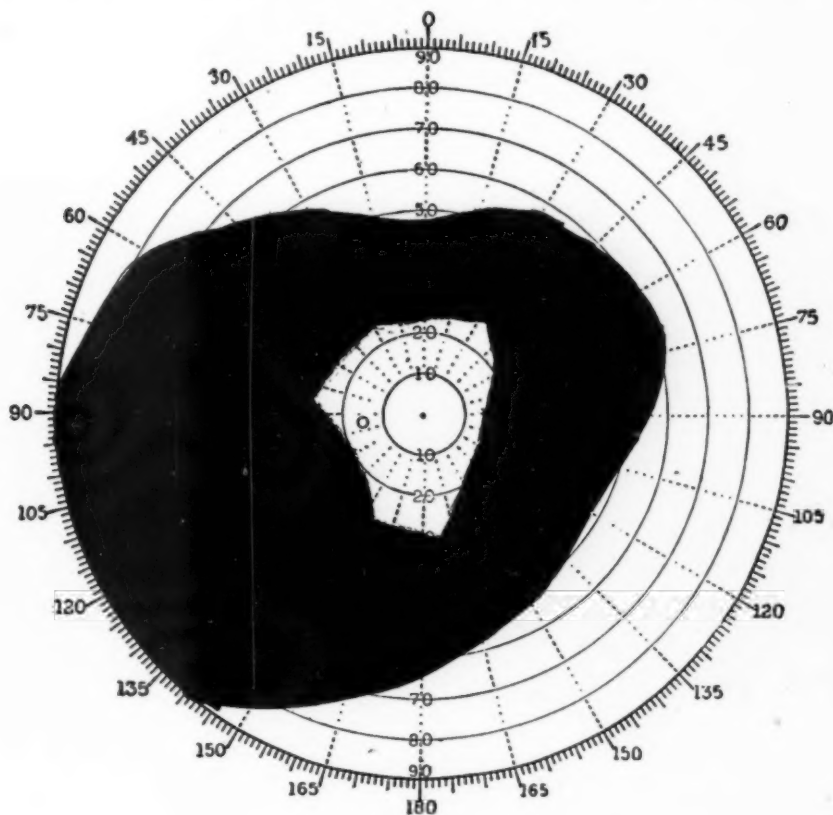


Fig. 2.—Form field of left eye, 1917, Jan. 5. Case 1.

happened three different times, always with the same surprise to me and the same relief when the vision turned into myself.

As I was dressing for breakfast one morning B. (four years old) came to my room and asked me why I had called him. I told him that I had not called him; that I had not been in his room. With big and startled eyes, he said, "Who was it then, that called me? Who made that pounding noise?" I told him it was undoubtedly the wind rattling his window. "No," he said, "it was not that, it was somebody that called me. Who was it?"

seem to be very much the matter with them and they appeared to be growing too fond of staying in bed, I made them get up and go for a walk in the sun. It was very hard to make them eat. B. would play vigorously for a little while, and then would lie, stretched out, limp and listless upon the floor, a toy in front of him clasped in his hand, his eyes glued upon it and yet apparently neither seeing nor thinking about it. About half an hour later, perhaps, he would suddenly get up and play again.

About this time my plants died. Some of them I had had for a number of years.

At this time I had a cold and cough, and ached all over as if I were going to have an attack of grip, but as I had no fever, I went about as usual. G. was not feeling at all well either. He had a great deal of pain at the back of his head and felt as if he was going to have ty-

but as everything was quiet he instantly dismissed that idea. It then flashed across his mind that I had been playing a joke on him, but upon looking at me, he saw that I was in a heavy sleep, very much as if I had been drugged. Until we lived in this house, I had always been

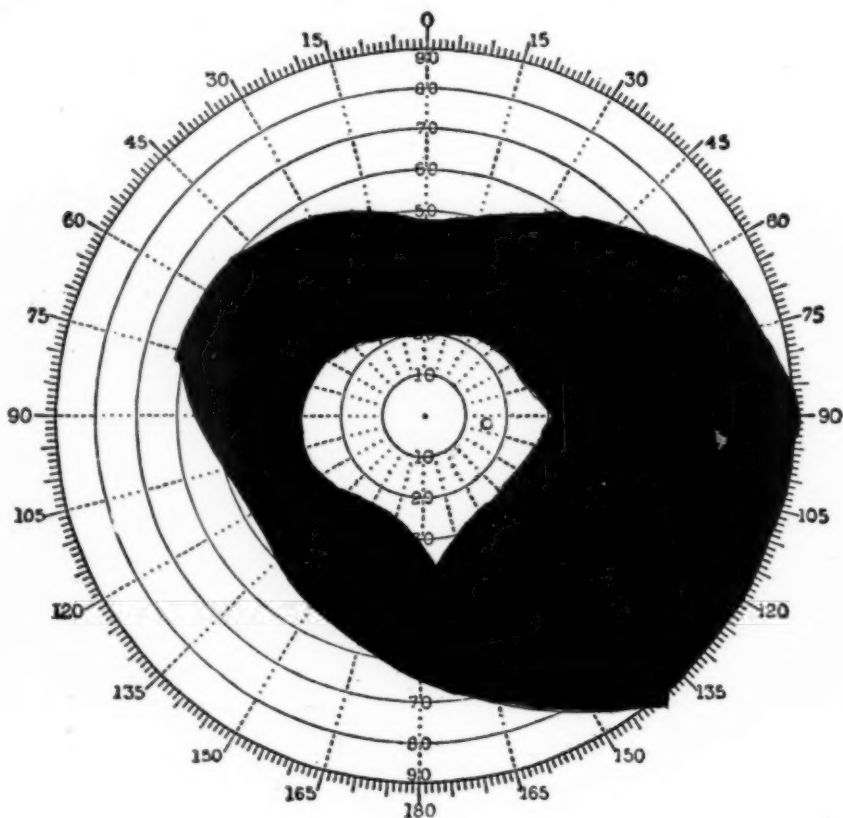


Fig. 3.—Case 1. Form field R. E., 1917, April 21.

phoid fever for a second time. The servants, too, had grown pale, and moved about the house listlessly.

On the night of January 15 we went to the opera. That night I had vague and strange dreams, which appeared to last for hours. When the morning came, I felt too tired and ill to get up. G. told me that in the middle of the night he woke up, feeling as if someone had grabbed him by the throat and was trying to strangle him. He sat up in bed and had a violent fit of coughing, which lasted about five minutes. His first thought had been that burglars were in the house,

a light sleeper, waking at the slightest sound. In this house, however, nothing seemed to wake or disturb me. Quite the contrary with G., for in the past he had always slept heavily, never hearing a sound and nothing disturbed him. Now he was continually waking, answering the telephone and doorbell, which had never rung, and looking for burglars, who never materialized.

That morning after breakfast, as was my usual custom, I sent for the children's nurse, a Scotch woman who had lived with me for several years. She looked worn and pale, and when I asked how

the children had slept she burst out with, "It has been a most terrible night. This house is haunted."

I laughingly told her that that was the most ridiculous thing I had ever heard.

"I would have said the same thing three months ago," she answered, "but

fat man touch me.' He was terrified. It took Fräulein and me until ten o'clock to calm him. He slept the rest of the night with me, in my room. Fräulein slept in B.'s bed, beside G. Jr., to protect him. G. Jr. did not wake up all night, but the muscles of his face kept twitch-

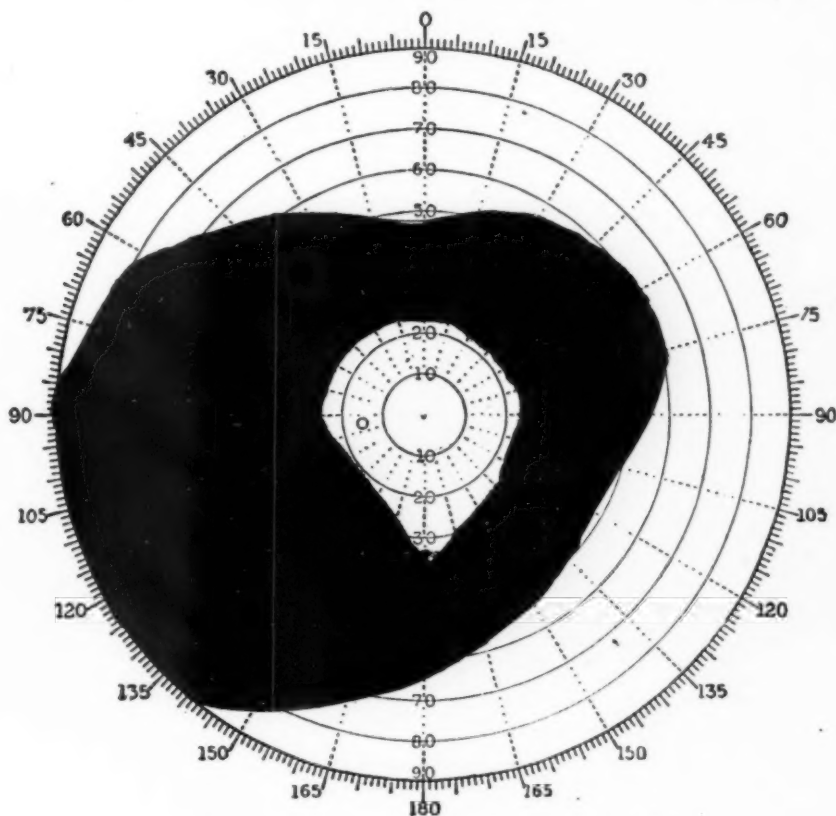


Fig. 4.—Case 1. Form field L. E., 1917, April 21.

I have had such experiences that I am now convinced of it, and everyone in the house has had experiences too." She said that after being in the house two or three days, things had begun to happen. She had not told me before, as she and the rest of the household had made up their minds that I ought not to be disturbed about it. "But last night," she continued, "when the children were attacked, it became my duty to let you know at once. While you were at the opera," she went on, "about half past eight, B. woke up and ran screaming thru the hall to my room, 'Don't let that big

ing, as if someone was continually pinching him. In the morning when he woke, he said indignantly to Fräulein, 'Why have you been sitting on top of me,' and when she told him that she had not been sitting upon him, but had been in the bed next to him, he said, 'No, you have been sitting on top of me, and you were awfully heavy, too.'

"Often in the evening, after the children have gone to bed, never until after dark and the lights are lighted, Fräulein and I may be laughing and talking, when all of a sudden we hear the heavy tread of an old man walking slowly and stead-

ily along the hall on the floor above us. It has not been one of the servants, for I have often run up stairs to see, and I have found the whole upper story of the house in darkness, and empty. Sometimes as I walk along the hall I feel as if someone was following me, going to

Sometimes, after I have gone to bed, the noises from the storeroom are tremendous. It does not happen every night; perhaps a week or ten days will pass, and then again it may be several nights in succession. Sometimes it sounds as if furniture was being piled against

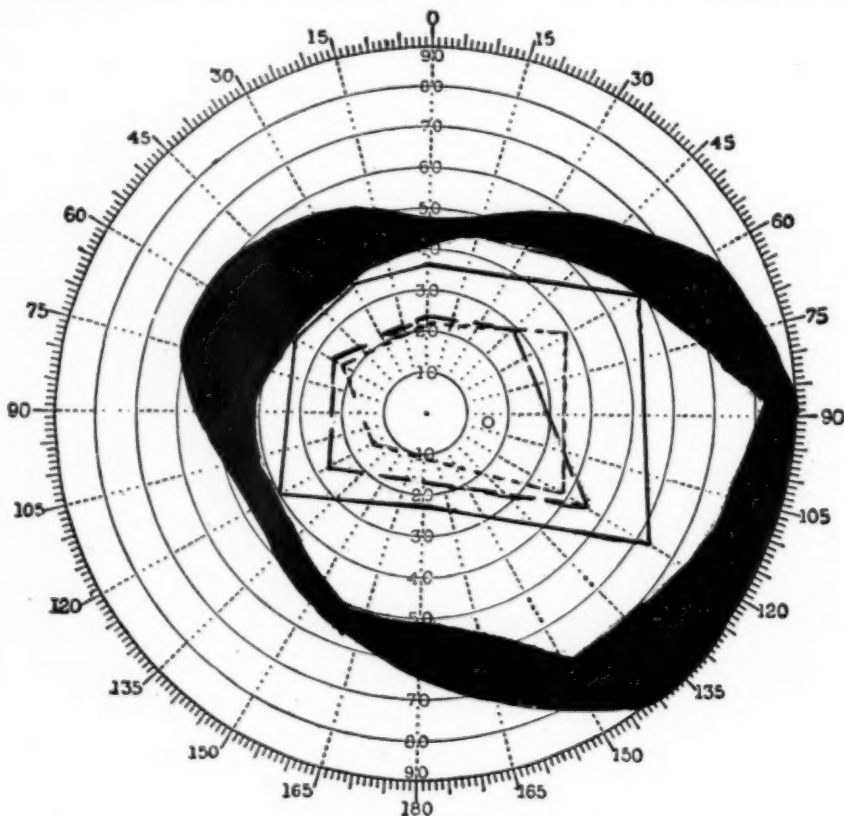


Fig. 5.—Case 1. Right fields, 1919, May 28. Form field, inner edge of black. Field for blue, continuous line. Field for red, line of long dashes. Field for green, short dashes.

touch me. You cannot understand it if you have not experienced it, but it is real. Some nights after I have been in bed for a while, I have felt as if the bed clothes were jerked off me, and I have also felt as if I had been struck on the shoulder. One night I woke up and saw sitting on the foot of my bed a man and a woman. The woman was young, dark and slight, and wore a large picture hat. The man was older, smooth shaven and a little bald. I was paralyzed and could not move, when suddenly I felt a tap on my shoulder and I was able to sit up, and the man and the woman faded away.

the door, as if china was being moved about, and occasionally a long and fearful sigh or wail."

The governess, Fräulein Y., then came to me. She also spoke of the heavy footsteps at night—like an old man in overshoes walking slowly along. She also heard the noise in the store-room, the moving and piling up of furniture. She slept in a big, four-post bed, with a canopy. One night, after she had been in bed a little while, she felt the bed shaken, and the canopy swayed. Thinking that a draught from the open windows might be causing the sensation, she

got up and closed them. She returned to bed, and after a short time the shaking of the bed was repeated. Again she got up, examined the room thoroly, but was unable to unearth anything.

I interviewed all the servants in turn. They all had heard at some time or other,

tales, we nevertheless felt as if there was a serious aspect to it. Why had all the servants whom we had had for several years, gone practically mad all of a sudden? We began to trace back the history of the house. The last occupants we found had exactly the same experiences

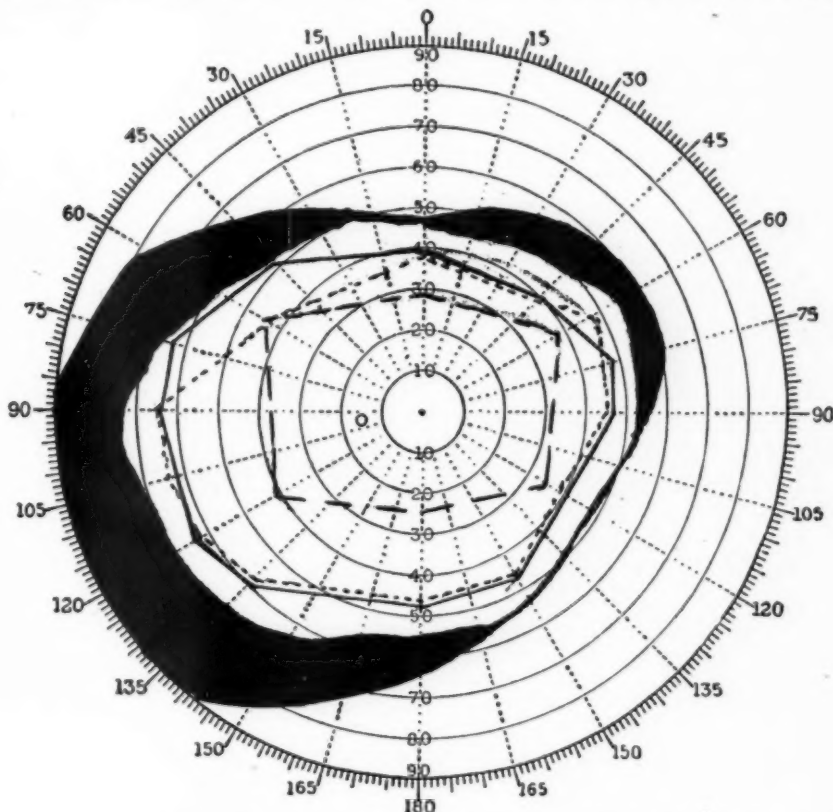


Fig. 6.—Case 1. Left fields, 1919, May 28. Form field, inner edge of black. Field for blue, continuous line. Field for red, line of long dashes. Field for green, short dashes.

the footsteps at night going slowly along the corridor outside of their rooms. Each one at first had thought it one of the others, and was surprised, after inquiring, to find none of them about. They all spoke of strange experiences after they had gone to bed; as if something crept around the bed and then over them, and then they were unable to move. Sometimes it lasted for a long time, sometimes shorter. Not every night, but perhaps every second or third night. It never happened to them all on the same night, but to one and then to another.

Much amused as we were by all these

as ourselves, with the exception that they stated that some of them had seen creeping around their beds visions clad in purple and white. Going back still further, we learned that almost everyone had felt ill and had been under the doctor's care, altho nothing very definite had been found the matter with them.

Saturday morning, the eighteenth of January, G.'s brother told us that he thought we were all being poisoned; that several years before he had read an article which told how a whole family had been poisoned by water-gas and had had the most curious delusions and experi-

ences. He advised us to see Professor S. at once. As he was out of town, his assistant, Mr. S., came at once to our house. We told him how listless and ill the children appeared. He found one of them lying on the floor, and the other two in bed. We related the experiences of

poisoned. He instantly ordered iron for them, and for the whole household. He also stated that none of us ought to stay in the house another night."

On January 5, 1917, when B. was eight years old (four years after he had been taken from the poisoned house), the

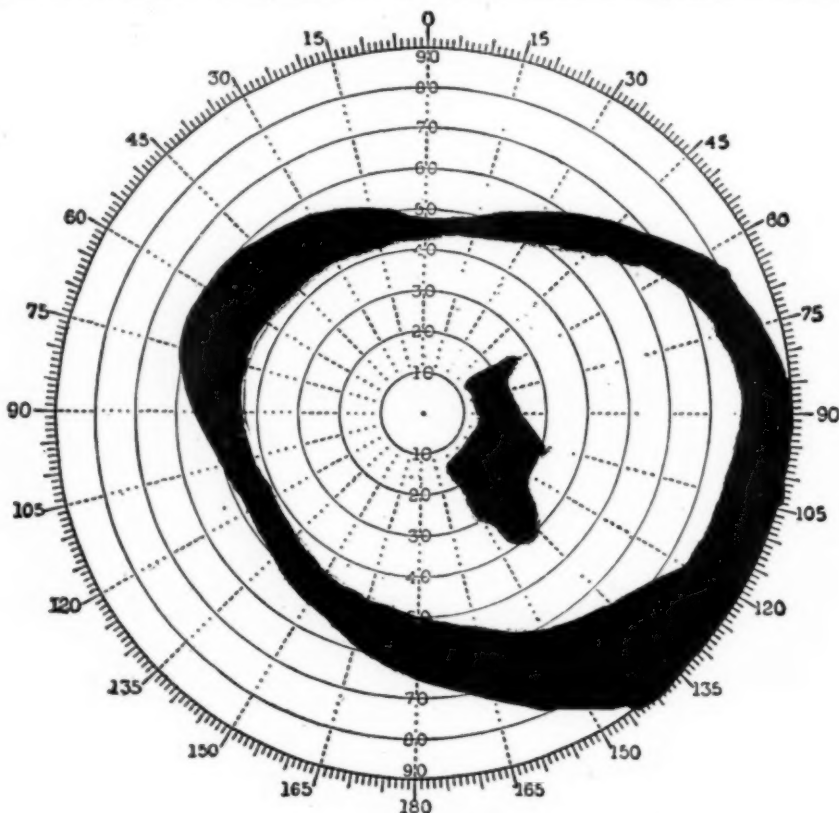


Fig. 7.—Case 1. R., 1920, March 22. Showing paracentral scotoma.

the children and servants, and told him about the plants. He examined the house thoroly from top to bottom and interviewed the servants. He found the furnace in a very bad condition, the combustion being imperfect, the fumes, instead of going up the chimney, were pouring gases of carbon monoxid into our rooms. He advised us not to let the children sleep in the house another night. If they did, he said we might find in the morning that some one of them would never wake again.

Early in the afternoon our physician arrived and examined the children and agreed with Mr. S. that they were being

writer examined the boy's eyes. His mother stated that of all the family he was the only one who seemed to have persistent symptoms following his exposure to the carbon monoxid fumes. In his case there had been some gastric disturbance and anemia. In addition, he did not do well in reading—miscalling letters—altho he was a very clever boy. His adenoids had been removed when he was three years old. Two operations on his tonsils had resulted in their removal. Tho he experienced numerous colds there had never been any recognizable sinus trouble. "About two years previously his eyes had been examined by Doc-

tor Proctor who had found a contraction of the visual fields." (In a recent personal communication Doctor Proctor says, at that time he had in mind hysteria as a cause of the eye trouble.)

Present condition: Externally the eyes were normal, pupillary reactions normal,

reexamined. At that time, his general physical condition was reported much better. R.E.V. = 20/40 with cyl. -0.50 at 45° = 20/30+. L.E.V. = 20/30; with cyl. -0.50 at 135° = 20/20+. Color vision still normal. Light sense seemingly a trifle diminished. Visual

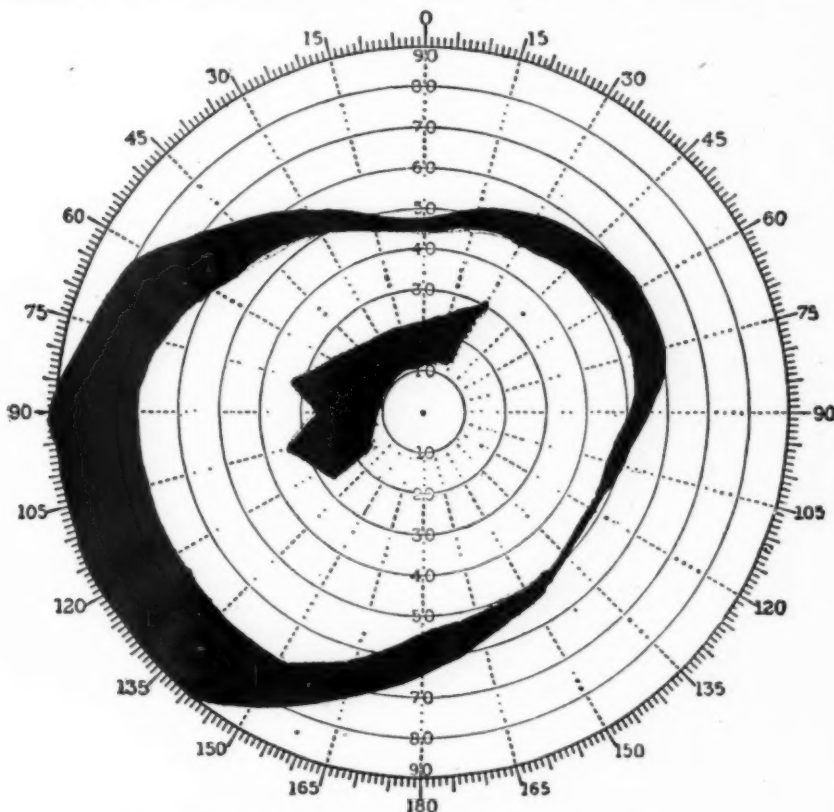


Fig. 8.—Case 1. 1920, March 22. L., showing paracentral scotoma.

motility and muscle balance good. The central vision was 20/20+ in each eye, accepting a cyl. $+0.25$ at 135° in the right and the same cylinder at 45° in the left eye. Visual fields much contracted (Figs. 1, 2). The fundus of each eye was practically normal. The discs, if departing at all from the normal, were a trifle hyperemic. The central color vision was very acute. On April 21, 1917, the patient's eyes were again examined. The tests were practically as at the last examination, three months and a half previous (Figs. 3 and 4).

On May 28, 1919, after a lapse of a little more than two years, his eyes were

fields improved (Figs. 5 and 6 fields for form and colors).

On March 22, 1920, B. was again presented for examination. Mrs. H. reported that for the last month his sight had seemed more normal. He had become very fond of reading and voluntarily read a great deal. The central vision and color sense were unchanged since the last examination in May, 1919. The visual fields were much enlarged but there was a marked paracentral scotoma in each eye. Blind spots enlarged. (Figs. 7 and 8 show form fields with paracentral scotomas. Figs. 9 and 10 show enlarged blind spots.)

The patient when first seen by the writer seemed to be recovering from an interstitial inflammation of both optic nerves of the type described as perineuritis by Peter and others. As the ophthalmoscopic changes were negligible, the diagnosis had to depend upon the history of the case and upon the visual

used alcohol in moderation and smoked from ten to fifteen cigarettes a day. About May 1, 1920, used a gasoline torch in a closed room, to remove paint from a mantel piece. For about two hours afterwards felt very faint, dizzy and nauseated; did not vomit; had headache; and could not continue the work. These symptoms disappeared in a short time. But two days later, vision became very blurred. This seemed to disappear after lasting two days. On July 1st, he used the torch in the same way in the same room all day and half of the next day; had to stop work several times owing to

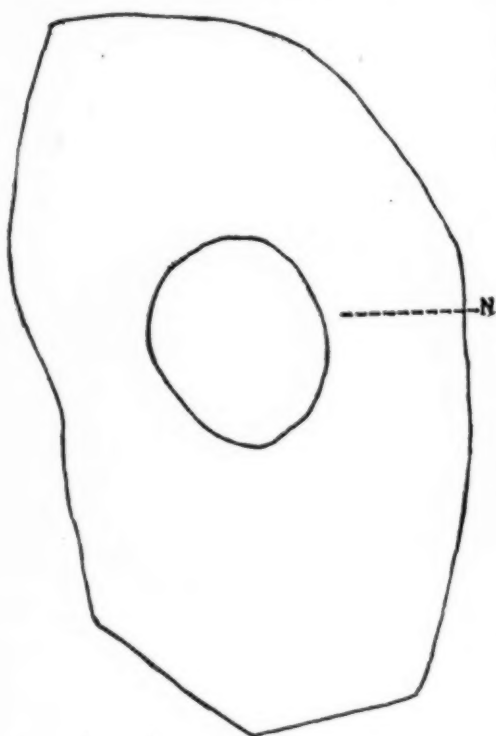


Fig. 9.—Case 1. March 22, 1920, showing enlargement of blind spot Right. N. outline for normal blind spot.

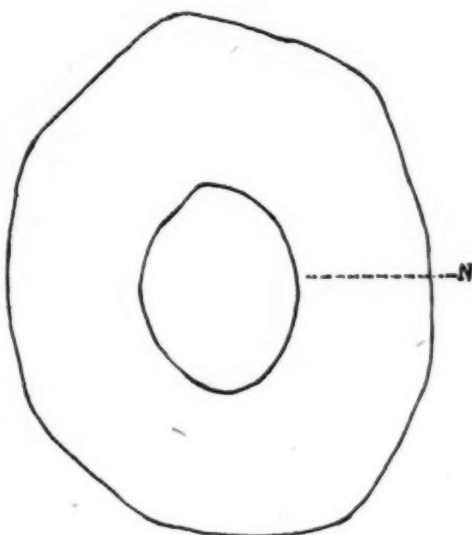


Fig. 10.—Case 1. March 22, 1920, showing enlargement of blind spot in Left. N. outline for normal blind spot.

fields. Nothing apart from the exposure to a poisonous gas could be found bearing a causal relation to the ocular disturbance. On October 1st of this year, Mrs. H. wrote concerning the lad: "He has developed a great taste for drawing and painting. I am sending a few samples of them, thinking they might interest you in regard to the development of his eyes."

The writer is indebted to Dr. J. W. Burke for the notes of the following case. The patient was first seen on September 11, 1920. J. E. B., 35 years of age, well nourished; never had a serious illness; family history good; habits good;

a recurrence of the symptoms experienced in May. Two days later, the vision again became impaired, and it grew steadily worse for ten days. But since that time, there has been practically no further change in the vision. Patient was carefully questioned about the possibility of having used wood alcohol, quinin, or other toxic substances; but no evidence in regard to such use could be elicited. Had seen several oculists who had pronounced his trouble optic atrophy. R.E.V. = 13/200; L.E.V. = 20/200. Jaeger 14 with difficulty. R.E. pupil $3\frac{1}{2}$ mm. and L.E. $4\frac{1}{2}$ mm. in diameter; reactions present but sluggish. Color sense

very defective. Fields contracted (Fig. 5).

Patient was treated by subconjunctival injections of normal salt solution and increasing doses of strychnin. While under observation, the central vision remained practically the same, tho later, on September 21, there was a slight improvement in the visual fields (Fig. 12).

The neurologic report stated that, apart from the eye condition, there was

additional cause of eye lesions. As carbon monoxide is present in all of the gases connected with domestic and industrial activities, it has possibly been responsible for certain obscure amblyopias that have been attributed to other often quoted chemical substances. And its causal relation may be obscured at times by some other very evident source of toxemia, such as septic tonsils, apical abscesses, syphilis, etc.

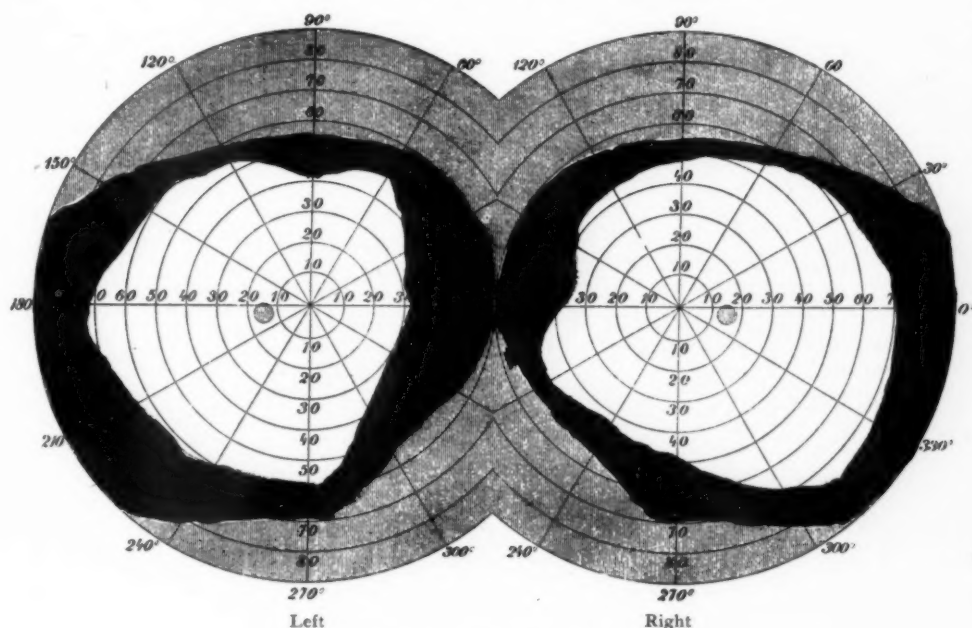


Fig. 11.—Case 2. Form fields, 1920, Sept. 11.

no evidence of an organic lesion of the central nervous system. There was, however, an absence of the achilles reflex as well as a distinct difference between the knee kick and the tendon reflexes of the upper extremities. The examination of the cerebrospinal fluid showed that the Wassermann reaction was negative, but that the protein content had been increased, and there were 20 cells per cu. mm. Examination of the blood negative in all particulars. X-ray of sinuses and sella turcica negative. Examination of feces negative. All other examinations made to discover a possible source of toxemia, were negative.

The exposure in modern life to the influence of carbon monoxid, introduces an

It is not of vital importance to the ophthalmologist whether carbon monoxid manifests its serious effects as a distinct chemic poison, or whether it deals destruction purely by its power of quickly depriving the blood of its essential oxygen-carrying power. But it seems to the writer, after much experience with pure oxygen want, artificially produced, that there is much truth in the two opposing theories. On the one hand, the physiologist sees the dramatic effect of carbon monoxid upon the person who takes one whiff of the concentrated gas and falls as if electrocuted; or he is interested in those cases which finally become unconscious after a longer exposure to fumes of lesser strength. Moreover, he

sees the results of experimentation in the laboratory, and he is quite rightly impressed by the effect of this gas upon the oxygenation of the blood. But he does not come in contact with the final consequences of the prolonged, but intermittent, exposures to infinitesimal doses of this gas—results which are of such interest to the clinician. In these cases, the symptoms run the gamut of clinical medicine.

etc. The ocular nerve lesions seem to be due to changes in the delicate structures of the nuclei of origin of these nerves.

However, thru its effect upon the sensitive fabric of the central nervous system, carbon monoxid does cause ocular paralyses, hemianopsias, disturbances of normal pupillary reactions, optic neuritis, and, actually, optic atrophy. Like pure asphyxiation, it is the source of great ocular congestion, and in this way it does

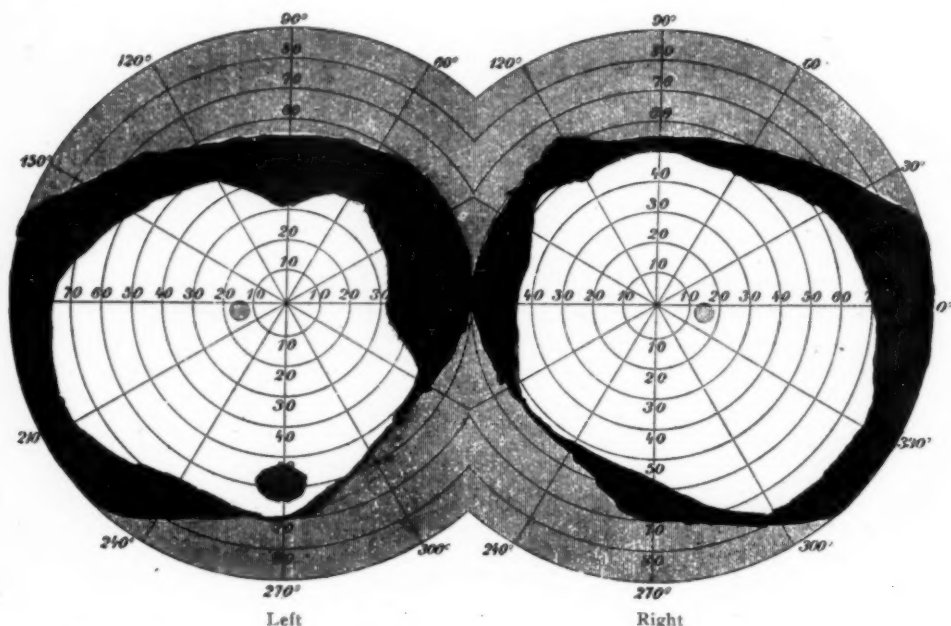


Fig. 12.—Case 2. Form fields, 1920, Sept. 21, showing some enlargement with scotoma in left.

The history of carbon monoxid convinces one that, apart from the effect upon the hemoglobin, it is chemically inert compared with the toxicity of other well-known chemic substances. However, one cannot but feel that after a prolonged attack upon the body tissues, it exerts a deleterious influence which is apart from its purely oxygen-depletion effect—tho the latter does sensitize the delicate structure of the central nervous system.

Carbon monoxid does not show any great predilection for exhibiting its toxic influence upon the optic nerve fibres as a whole, nor even upon the very sensitive papillo-macular bundle which is so markedly affected by alcohol, nicotine,

cause subconjunctival and retinal hemorrhages; while in the milder cases of carbon monoxid poisoning congestion of the respective cerebral centres causes hallucinations of vision, hearing and touch.

The writer feels that the first case reported is one of optic neuritis due entirely to carbon monoxid poisoning. This seems to be a logical conclusion to draw from the history of the case, the great general disturbance, the very slow recovery, the elimination of every other toxic source, and the recognized susceptibility of children to this gas.

In the second case, carbon monoxid is the probable cause of the optic atrophy, by reason of the very clear history of

ocular and other disturbances that followed each exposure to its fumes, and the exclusion of all other toxic sources.

The treatment seems to resolve itself into remedies suggested by the symp-

toms, prophylaxis, hygiene, and the legislation that should follow the proper education of the public in regard to the insidious toxicity of this "Frankenstein" of advanced civilization.

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(1) EPIBULAR CARCINOMA NINE YEARS AFTER REMOVAL OF A PAPILLOMA OF THE CORNEOSCLERAL MARGIN; (2) SMALL, SPINDLE-CELLED HEMANGIOSARCOMA OF THE EYELID OF A CHILD AGED FIVE MONTHS, EXCISION FOLLOWED BY RADIUM TREATMENT; (3) PATHOLOGIC HISTOLOGY OF A CONCUSSIONED EYE FOLLOWING GUN-SHOT WOUND OF ORBIT.

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PHILADELPHIA.

This paper reports especially the significant microscopic findings throwing light on the pathologic history of these cases. It was read at the meeting of the American Ophthalmological Society, June, 1920.

The object of this communication is to present the clinical histories of the cases described in the title, as well as the pathologic examinations of the specimens, without analysis of the literature, or reference to similar lesions and growths, except in incidental mention.

CASE I. *Epibulbar Carcinoma*. J. R., laborer, male, white, aged eighty, was admitted to the Eye Ward of the University Hospital December 2, 1919, for the treatment of an epibulbar growth of the left eye of large size.

Medical and Family History: Except for repeated attacks of rheumatism, one attack six years ago being especially severe, the patient's medical history is unimportant. The causes of the death of his father and mother are unknown; his wife died of tuberculosis; there is no family history of carcinoma.

Eye History and Examinations: In October, 1910, or nine years prior to his second admission to the hospital, he had applied for treatment of a small tumor at the corneoscleral junction.

The uncorrected vision of the right eye at this time was 6/22, and it revealed no pathologic condition. The uncorrected vision of the left eye was 6/45. The growth referred to, somewhat crescentic in shape, was situated along the inner border of the corneo-scleral junction, and extended from the center of the upper corneal border around its inner margin to the center of its lower border. Directly in its middle, on a line with the internal rectus, the growth was depressed, owing to the presence of a small pterygium. It appeared to arise in two portions above and below it. The

neoplasm was attached by a broad base, which encroached for 4 mm. on the corneal surface and about 6 mm. on the bulbar conjunctiva. It was smooth on its surface, and of a reddish-yellow color; a number of injected conjunctival vessels surrounded its margins (Fig. 1).

The patient maintained with positiveness that the growth had begun to appear after his eye had been injured by coming in contact with the fin of a sunfish, which struck him violently in the corner of the eye, and occasioned primarily a stubborn traumatic conjunctivitis. Exactly how long a time elapsed between the date of the injury and the development of the tumor as it appeared at the time of examination is not known. According to the patient's statements, it was between three and five years. The tumor was excised, and the gap produced by the dissection covered with conjunctival flaps. Healing was uneventful, and the patient left the hospital at the end of a week.

To the microscope the growth revealed the following characteristics: Externally there was a layer of stratified squamous epithelium arranged in a papilliform manner, while between the papillae there was a rather dense connective tissue growth. This layer of epithelium surrounded an area consisting for the greater part of dilated capillaries and arterioles filled with blood-cells. The remainder of the growth was composed of myxomatous and connective tissue. The epithelial elements were in no sense infiltrated, and had a definite relation to the basement membrane. Many of the cells showed distinct chro-

matin filaments in their nuclei, and in one spot there was an appearance suggesting pearly body formation.

Physical Examination: At the time of the patient's second admission to the hospital (December 2, 1919), nine years after the removal of the epibulbar papilloma which has been described, the



Fig. 1.—Papilloma of the corneo-scleral border, followed nine years after its removal by an epibulbar carcinoma.

physical examination revealed the following conditions: Lungs negative; heart slightly enlarged to the left, with weak muscle sounds and a loud systolic murmur over the aorta and at the mitral area; rhythm good, and no evidence of decompensation; no dyspnea or edema.

The urine was without sediment, free from albumin and sugar, and contained neither casts, cylindroids, nor crystals. Blood count: Erythrocytes, 3,820,000; leukocytes, 6,000; hemoglobin, 70 per cent. Blood pressure, systolic, 155; diastolic, 95.

Eye Examinations: R. E.: Negative except for a few striae in the lens. L. E.: Protruding between the lids there was a

large, fungus-looking mass, approximately 2 cm. in height, arising from the upper corneo-scleral region, overhanging and partly adherent to the cornea in front, and extending backward along the scleral expanse for 2 or 3 cm., and apparently involving the tissues more posteriorly in the orbital cavity. The fundus could not be seen, owing to the haziness of the uncovered part of the cornea. The growth bled easily, was of a dirty grayish color, and the patient suffered considerable pain deep in the orbit and in the periorbital region.

Operation: Removal of the eyeball, and, if necessary, removal of the orbital contents, was advised, and on December 5, 1919, this procedure was adopted:



Fig. 2.—Epibulbar Carcinoma and adjacent orbital tissue.

The contents of the orbit, together with the eyeball, were exenterated in the usual manner, and the bleeding controlled by packing and pressing against the apex of the orbit some surgical wax. The cavity was loosely packed, and directly in the center of the packing two radium bullets were placed, each containing 30 mgm. of radium element, which remained in position for eighteen hours. Convalescence proceeded without complications, and the patient was discharged four weeks after the operation, the orbital cavity being free from suppuration and markedly contracted, the only dressing required being a small

ball of surgical gauze. Up to the present time no report has been received from the patient indicating any return of the growth, altho he has not actually been examined in the hospital since January 14, 1920.

Gross Appearance of the Specimen:
Glycerin-jelly mount of half of the eye-

there is a punched out, central ulcer. The lens has been slightly dislocated backward, and there is extensive detachment of the retina, but no gross signs of exudation, inflammation, or neoplastic tissue within the eyeball, which is of normal size (Fig. 2).

Microscopic Appearances of the

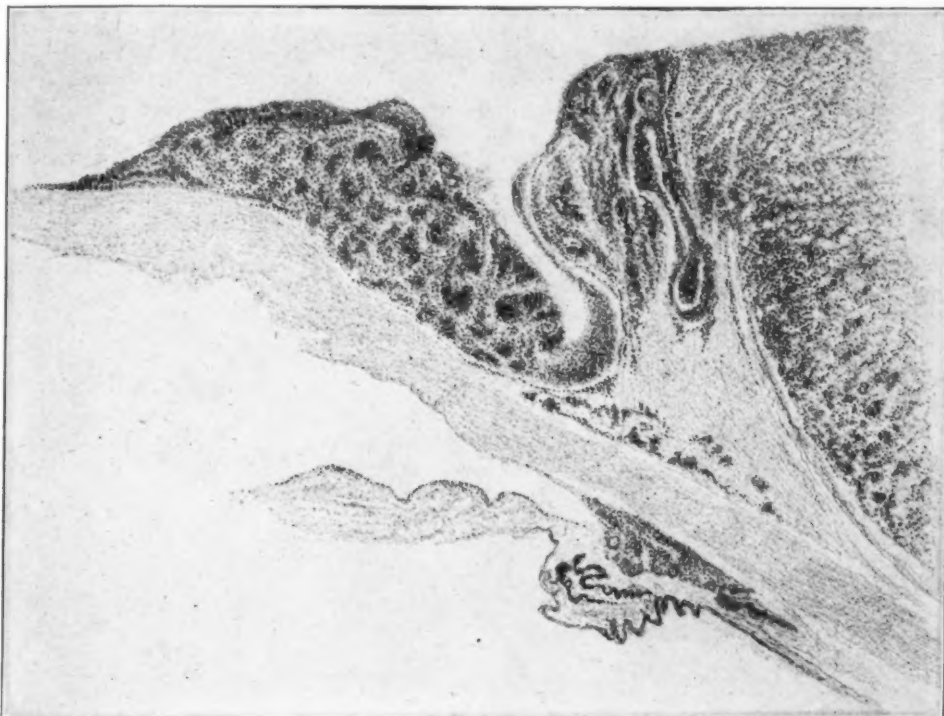


Fig. 4.—Nests of cancer cells in a delicate connective tissue stroma. (High power, b. Low power, a.)

ball, including a mushroom shaped tumor, which arises from the conjunctiva of the corneo-scleral junction and extends posteriorly, together with the adjacent orbital tissue. The growth is in close contact with the sclera, but does not penetrate it. The tumor included in the specimen, about 1 x 1.5 x 2 cm., is circumscribed, nonencapsulated, and has a lobular exterior. The cut surface of the growth is of a dirty white color, surrounded by a marginal zone of varying thickness. A lobule of the neoplasm has encroached upon the upper cornea for a distance of about half a centimeter. The cornea is hazy, and

Specimen: The tumor is composed of small, squamous epithelial cells, and has originated in the conjunctiva, at or just posterior to the limbus, or, in other words, at the position occupied by the upper part of the papilloma removed nine years previously. The growth is entirely extraocular; the bloodvessels underlying it in the limbic zone are engorged, with marked perivascular round celled infiltration. The sclera is without special pathologic features, and the cornea shows only the evidence of pressure edema and the lesions of the central ulcer before noted. Both retina and choroid

are largely detached. Distributed along the choroid posteriorly, and between it and the sclera there is a moderate amount of deeply eosin stained, vacuolated exudation of blood origin. There are no evidences of inflammation (Figs. 3 and 4).

Fragments of the deeper orbital tis-

years after its removal (the exact period is not known), an epibulbar, squamous celled carcinoma, taking its origin at the upper part of the area from which the original growth was removed.

The probable relation of an injury to the development of a papilloma of the limbus, as in the present case, is inter-

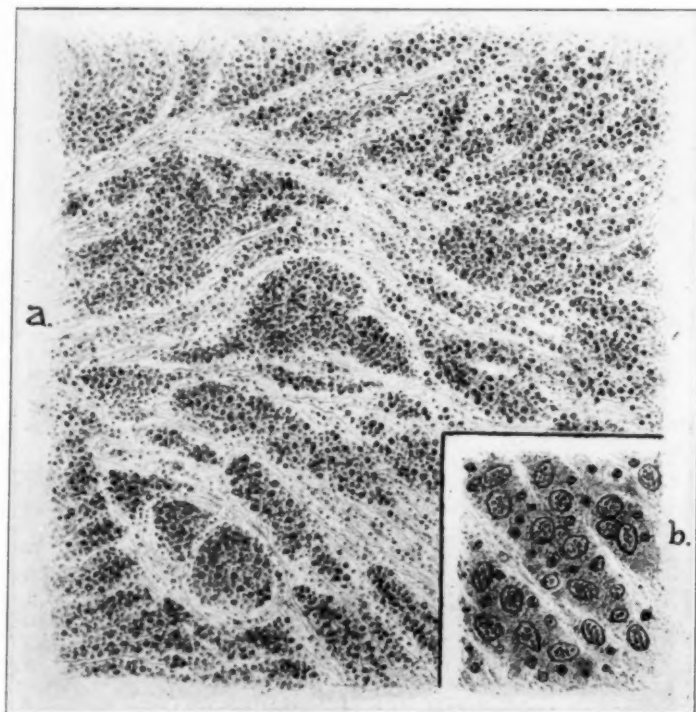


Fig. 4.—Nests of cancer cells in a delicate connective tissue stroma. (High power, b. Low power, a.)

sue are composed of normal areolar fatty tissue, bloodvessels, nerves, and voluntary muscle. Sections of the tissue of the orbit adjacent to the growth are composed of the normal structure of this region, save only for considerable infiltration, which suggests chiefly the effects of traumatic hemorrhage, but does not definitely exhibit neoplastic tissue.

Comment.—After an injury from violent contact with the spines of the fin of a fish, followed by a prolonged period of traumatic conjunctivitis, in turn succeeded, about three years later, by the development of a papilloma at the corneoscleral junction, there originated, several

esting and well known. The invasion of the cornea is usually a later process. That recurrence in the form of an epithelioma may follow removal of a papilloma in this situation has been noted in not a few instances, and it is suggestive that the microscopic examination of the original growth revealed in one spot an appearance resembling pearly body formation. When this papilloma was excised, radium treatment of such a neoplasm was practically unknown, nor was the method of electric desiccation available. I think it likely that such a technic in the treatment of a growth of this description offers a better chance of avoid-

ing a recurrence in a malignant form than excision.

Of practical importance in connection with epibulbar carcinomas is invasion of the interior of the eyeball, which in the present instance did not take place. Shumway and I, discussing this question in a paper before this Society in 1913,¹ have quoted some opinions and statistics which are here reproduced: Some authors, for example, Axenfeld, Greeff, Wintersteiner, and Saemisch, consider that epibulbar carcinomas rarely penetrate the globe, while Ginsberg and Parsons express an opposite opinion. In 53 eyeballs with epibulbar carcinoma, the records of which we found in the literature, perforation occurred in 20, or 37.6 per cent. Hence, altho the cornea and sclera offer a considerable resistance to the growth of the tumor, especially if Bowman's membrane is intact, it is evident that perforation occurs in a considerable number of cases, especially if the neoplasm has been present for a long period of time. Naturally, this percentage is relatively too high, because the eyes examined were those in which the lesion had assumed serious proportions demanding enucleation.

Frequency of perforation depends largely upon the site of the tumor. It has been found that those growths which are situated at the corneal limbus are much more apt to penetrate the globe than those placed at a distance from it, and, as is well known, the region of the penetrating ciliary vessels presents a feeble resistance to a growing carcinoma, because its cells invade the tissue along the perivascular lymphsheaths.

As the microscopic examinations of the orbital tissue adjacent to the tumor did not definitely reveal neoplastic tissue, it may be questioned whether exenteration of the orbit was necessary, and yet only three months after the enucleation of an eye with the epibulbar carcinoma, reported by Shumway and myself, altho exploration of the orbit failed to reveal suspicious tissue, there was a large recurrence requiring a complete exenteration of the orbital contents. With this case in mind, and because of the apparent involvement of some of the orbital

tissue close to the tumor, removal of the entire orbital contents was justified.

The use of radium after the operation requires no comment, save only to point out that it lessens the danger of recurrence, seems to enhance the rapidity of the healing process, and undoubtedly ameliorates postoperative pain and discomfort.

CASE 2.—*Small, Spindlecelled Hemangiosarcoma of the Lower Eyelid of a Child Aged Five Months.*—F. K., a white female infant of five months, was admitted to the Eye Ward of the University Hospital on November 24, 1919, because of a tumor of the right lower eyelid.

History: Ten weeks prior to admission the child's mother first noted a "blue mark" along the eyelid. This rapidly increased in size until the whole lid was involved. The child, a first baby, has always been healthy, was exceedingly well nourished, and the general physical examination was entirely negative.

Ocular Examination: Both eyes were normal in all respects, and the conjunctival surfaces healthy. Extending practically the entire length of the right lower lid, there was an oblong swelling of bluish color, slightly lobulated to the touch, with which were associated a series of cords assumed to be distended vessels. The skin surface appeared to be normal, the integument was not adherent to the underlying tissue. The tumor became turgid, purplish in color, and seemed to increase in size when the child cried. A tentative diagnosis of cavernous angioma was made and its removal advised.

Operation: An operation was performed on November 27, 1919, and the growth dissected from its bed. On exposure it was found to be covered with a delicate, translucent tissue, which evidently was not adherent to the growth, from which it was easily stripped. On the surface of the tumor were a number of large veins of bluish color. The neoplastic tissue was of a slightly reddish-gray color, and apparently took its chief point of origin from the outer end of the lid. The wound was closed with interrupted silk sutures, leaving at the

outer end a small orifice thru which a radium tube (dosage, 15 mgm.) was inserted beneath the suture line along the length of the incision, and allowed to remain in place for ten hours. Very little reaction followed this procedure, and at the end of four days the child was discharged, the wound being completely healed.

cells. Some of the bloodspaces show a characteristic "combing" of the cells which form their walls. Areas of hemorrhage are visible in the interstitial areolar tissue. There is no melanotic pigmentation. The growth, therefore, is a small, spindlecelled hemangiosarcoma (Fig. 5, *a* and *b*).

Comment.—A goodly number of cases



Fig. 5.—Small spindle celled hemangiosarcoma tumor lobule made up of spindle-cells and blood sinuses. (Low power, A.) Blood channel walls formed of tumor cells which show characteristic "combing". (High power, B.)

Microscopic Examination: The growth, nonencapsulated and irregular in outline, is composed of variously sized round and oval islands of tissue, separated one from another by areolar fatty and fibrous connective tissue. These islands are all similar in structure, and are composed of numerous blood channels supported by densely packed and irregularly arranged spindle cells of the young connective tissue type. A few of the largest bloodspaces have poorly developed walls, chiefly made up of connective tissue, but the walls of all of the capillary spaces and many of the larger blood sinuses are composed of tumor

of sarcoma of the eyelid are on record, and in this country statistical information in this regard has been published by Wilmer (1895), Veasey (1899), Alling (1907), and Shumway and myself (1911). At the time of the last named report at least 80 cases had been described, and since then others have been reported. In the collection made by Shumway and myself² in 43 per cent of the cases the sarcoma was roundcelled, in 40 per cent spindlecelled, while in the remainder the cellular type was mixed. Between 30 and 40 per cent of these lid tumors are pigmented. Parsons records 11 per cent of myxosarcomas. Angio-

sarcomas and cylindromas are said to occur more frequently than myxosarcomas. Some of the reported cases of roundcell sarcoma were probably lymphomas.

In Wilmer's list the age of the patients affected varied between ten months and seventy-six years. I have removed a sarcoma from the lid of a negress aged eighty-one. Five months, the age of the subject of this paper, must place this patient among the very youngest of those whose histories have been published.

Altho often small at the time of their removal, some of these tumors reach unusual size, especially the myxosarcomas. I have recorded one such growth which attained a weight of 247 grams; its size was 10 by 8 by 6 cm.

Up to a month ago there was no evidence of recurrence of the tumor described in this communication, but quite recently (June, 1920) the child was examined, and below the line of incision, at the outer end of the lid, a distinct bluish color is visible, altho no growth can be detected on palpating this area. This coloration, however, is certainly suggestive, and the child will be under constant observation and, if required, radium treatment.

CASE 3.—Concussioned Eye Following Revolver-shot Wound of Orbit; Microscopic Examination of the Enucleated Globe.—J. C., a colored man aged thirty, was admitted to the Eye Ward of the University Hospital on September 10, 1919, within one hour after he had been shot thru the right orbit with a 45-caliber revolver, held at close range.

Physical Examination: The patient, a well nourished adult, was badly shocked and rallied rather slowly under anti-shock treatment. General physical examination failed to reveal any abnormal condition other than that produced by the injury. The bullet had entered the left side of the nose on a level with the eyes, had traversed the ethmoid (as shown by the X-rays), crossed the orbit, and was lodged in a region outside of its walls to the right and below the apex.

Ocular Examination: Except for a few powder burns of the lid, the left eye was normal and had normal vision.

The right eye was markedly proptosed, the conjunctiva intensely chemotic and ecchymotic, the lids swollen and containing extravasated blood. The cornea was clear, the shape of the eyeball apparently unchanged, and the ophthalmoscope revealed in typical profusion the lesions which Colonel Lister has described as those peculiar to the "grossly concussioned fundus."

Everywhere there were sheets and clouds of hemorrhage; the disc was only dimly made out, being partly covered with blood, and completely surrounded by widespread areas of hemorrhage. Here and there were white patches. Some of the blood was apparently pre-retinal in situation, but there was no free hemorrhage in the vitreous. The eye was entirely blind. The tension, as far as it was possible to measure it, was neither elevated nor lowered. The patient suffered much pain. Within twelve hours the cornea was too steamy to allow further study of the fundus, and a small, yellowish infiltration began to appear slightly below its center. The exophthalmos and the pain had markedly increased.

The eyeball was therefore enucleated, and showed no sign of rupture, altho carefully inspected. The tissues of the orbit were infiltrated with blood, and the wound of exit thru the outer orbital wall far posteriorly was explored without detecting the bullet. About 10 mm. of the orbital nerve was secured, and its coats were intact, altho evidently bruised, but it had not been jerked from its entrance point into the globe. The patient made an uncomplicated recovery, and was discharged from the hospital one week after admission.

Microscopic Examination of the Eyeball and Optic Nerve: A large number of sections of the eyeball (22) and of the optic nerve (39), were prepared. The cornea is somewhat conical in shape, and contains no lesions other than those which were clinically evident. At the limbic region of the cornea there are vascular engorgement, interstitial hemorrhage, and lymphocytic and polymorphonuclear infiltration.

The anterior chamber is deep and free

from exudate. The lens occupies its normal position and shows no pathologic changes. The iris and ciliary body are congested and markedly edematous. The vitreous is negative.

The retina is widely detached on one side (Fig. 6, *a*), and everywhere is the seat of extensive areas of hemorrhage,

leukocytes. The lamina cribrosa stands out sharply, and is accentuated by an almost total destruction of the optic nerve-fibers. The nerve fibers which remain exhibit edema, hydropic degeneration, and are infiltrated with lymphocytes and polynuclears. The fibrous septa are also thickly infiltrated.

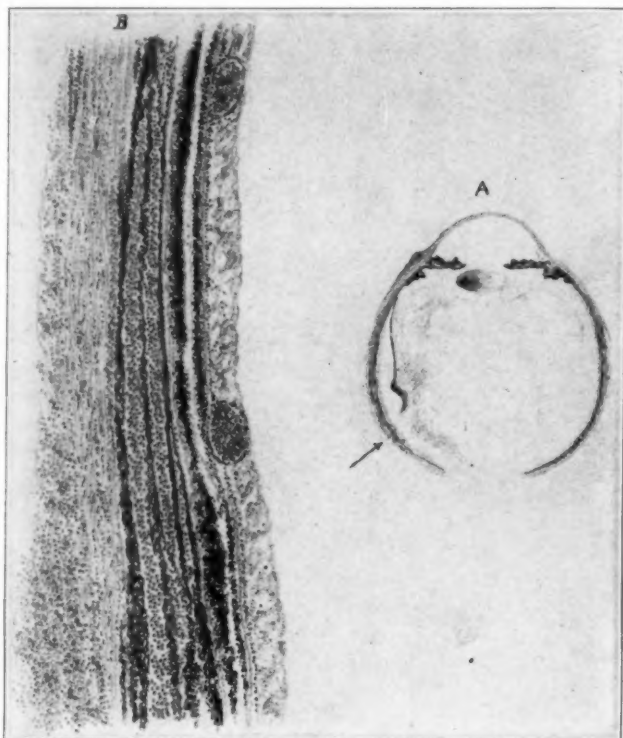


Fig. 6.—(a) Separation of retina on one side and position from which section of retina, choroid and sclera was made. (b) Section of retina, choroid and sclera showing distribution of hemorrhage as noted in text.

most marked in the layers of the rods and cones. In all its layers are the evidences of cellular distortion due to co-existing edema.

Thruout the choroid there are numerous and extensive interstitial hemorrhages. Except for the presence of superficial areas of hemorrhage, the sclera exhibits no lesions (Fig. 6, *b*).

Examination of a number of serial sections (1-13) of the optic nerve (retrobulbar and transversely cut) reveals the following conditions: The central vessels contain a few red cells and many

Between the pial and dural portions of the optic nerve sheath there is an area of hemorrhage which circumscribes the nerve. The extradural lesions included in these sections are the seat of interstitial hemorrhage, edema, and lymphocytic and polynuclear infiltration (Fig. 7).

The sections of the optic nerve as it enters the globe (27-37) indicate considerable swelling of the nervehead. The fibers are degenerated, finely vacuolated, and thickly infiltrated with lymphocytes; an occasional polymorphonuclear is vis-

ible. The cause of this swelling of the nervehead appears to be an acute inflammatory condition. Special tangential sections of the posterior pole of the eyeball, not including the optic nerve, show, in so far as the retina and choroid are concerned, the hemorrhagic lesions already described.

Comment.—Many concussioned eye-

cussion had produced the ophthalmoscopic lesions which have been described, added to which are those evident within the sheath of the optic nerve. These lesions antedate by a considerable time those which occur secondarily, the most important being atrophic chorioretinitis (spots of atrophy, exposed scleral areas and pigment distribution, heaping and

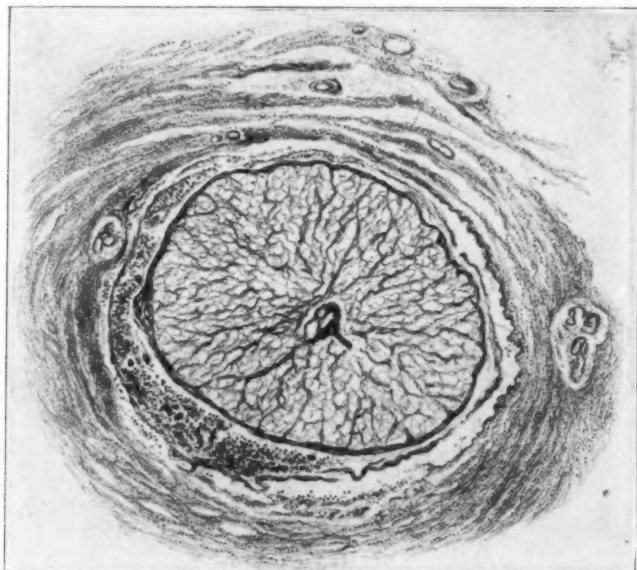


Fig. 7.—Transverse section of optic nerve. Atrophy of fibers, perineural hemorrhage, fibrosis of dura with intradural hemorrhage and perivascular (melanotic?) pigmentation.

balls, both in early and late stages, have been examined ophthalmoscopically and microscopically during the late war; and we are indebted especially to Colonel Lister, to Lagrange, and to v. Szily for information in this regard. Some of these data, as well as some of my own observations, I have summarized in a paper entitled "Concerning Concussion and Contusion Injuries of the Eyes in Warfare."³

Evidently the case in question belongs to that group in which the concussion results are produced by the passage of a missile thru the orbit behind without rupture of the globe. Its chief interest resides in the fact that the eye was secured very early after the effects of the con-

fringing) and proliferating chorioretinitis. This secondary chorioretinitis proliferans is essentially a cicatricial process, with organization of hemorrhages. But this is of less importance than the irritating effect of the hemorrhages, already noticeable in specimens, on the connective tissue of the retinochoroidal layers inciting them to active proliferation and the formation of tracts, areas, and masses of fibrous tissue. The whole process and picture differ materially from the so-called proliferating retinitis of recurring hemorrhages in the vitreous, especially in young subjects, often noted in civilian life. Of marked interest are the extensive degeneration of the optic nerve fibers and the lymphocytic and polynuclear infiltration, as well as the

hemorrhages in the optic nervesheath which have many times been noted in eyes examined after concussion injuries during warfare. Evidently in this case the missile, passing thru the orbit, bruised but did not penetrate the eyeball, and caused the extensive hemorrhagic lesions of the retina and choroid; bruised but

did not cut across the optic nerve, and caused a rapid destruction and hydropic degeneration of most of its fibers and a hematoma of the sheath. These conditions also explain the marked papilledema, microscopically evident, which was beginning to take on the lesions of an acute inflammatory edema.

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PRIMARY EPIBULBAR CARCINOMA.

F. PHINIZY CALHOUN, M.D., F.A.C.S.

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This paper reports a case in which after repeated operations upon the growth there had been no recurrence after six years. The pathologic specimens were examined by different pathologists who concurred in the diagnosis. Read before the American Academy of Ophthalmology and Oto-Laryngology, October 1920.

The subject of epibulbar carcinoma is ever an increasing one, and the following case offers some features which seem worthy of recording.

D. McC., age 64, a farmer and merchant of Mississippi, was seen in 1914, complaining of defective vision in the

gium was removed from the left eye, and two years afterwards a growth developed on the globe of the same eye, which was pronounced malignant. Later he states that an Eastern confrere of note expressed an opposite opinion after the bulbar growth had been entirely removed at this last consultation. The eye remained quiet until six weeks before he came under my observation, when noticing a tumor formation in the lower lid, the patient again consulted a surgeon in a neighboring city. From the statement which I received, the growth was evidently mistaken for a granulating chalazion, as an attempt was made to incise and curette it which operation caused the growth to enlarge.

A physical examination of the abdominal and thoracic viscera did not reveal anything abnormal, yet the man was decidedly underweight. An examination of the blood and urine showed that they were within normal limits for one of his age. On the left side of his neck, the right shoulder and dorsal surface of the left hand were small dry epitheliomatous areas which had been present many years.

Eye examination: O. D. 20/40 + 2.00 ax. 45° = 20/20. There was a slight drooping of the upper lid and the conjunctiva showed a few scars from an old trachoma. There was seen a small corneal scar at the nasal limbus, evidently the remnant of an atrophic pterygium. The fundus and tension was normal. O. S. 18/200. The upper lid drooped considerably, there was a decided entropion and most of the lashes were missing from epilation. There was a small peripheral corneal scar from a pterygium operation, and the cornea was well covered with an avascular pannus. The conjunctiva of the upper lid showed trachomatous scars. The cul-de-sac of the lower lid was completely obliterated



Fig. 1.—Primary epibulbar carcinoma.

left eye, but more especially of a tumor formation of long standing in the left lower lid, which recently had rapidly grown in size.

There is no history of cancer in the family, and the patient's father died in his 84th year from "old age." His mother died of tuberculosis in middle life and there is also a sister who died of the same malady. The other members of his family are living and reported to be healthy.

The patient states that with the exception of two attacks of influenza he has been remarkably healthy and has always led an active out of door life.

His vision had been good until eighteen years ago when "wild hairs" caused considerable irritation to his eyes. A ptery-

by a tumor about the size of a hazel nut, which was firmly attached to the sclera, and the globe could be moved by any motion of the tumor. The upper limit of the growth was slightly above the lower limbus line and there were evidences of recent instrumentation. The integument was freely movable over the tumor and when the lids were gently

suggested the application of radium. A tube containing 20 m.g. was applied to the raw surface of the lid for an hour and thirty minutes. As there was no reaction, another application for two hours was made two weeks later, and again repeated in two weeks for two and a half hours with an intense reaction to the lids and globe. The edema subsided

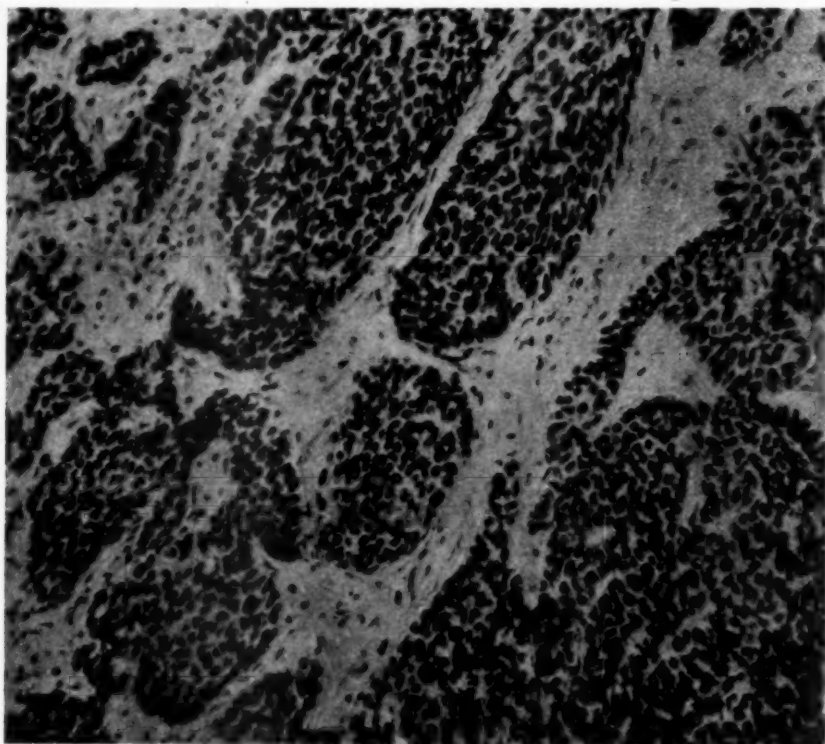


Fig. 2.—Section of primary lid tumor. Typical of carcinoma. Low magnification.

closed, the external appearance very much resembled a large chalazion.

Being of the opinion that the tumor was malignant, I urged that an enucleation be done if a pathologic report confirmed the clinical diagnosis, to which he positively refused. He only desired the removal of the growth, which was performed under ether anesthesia.

The growth was easily exposed and to my surprise, it readily "shelled out" from its scleral attachment. No effort was made to close over the raw surface.

Two days later I received the report that the tumor was carcinoma and I

entirely in six days when the patient was temporarily dismissed. Marked contraction was taking place in the lower lid, with the lid adhering to the globe.

Two months later the patient returned for observation and the vision had improved to 20/70; the cornea was remarkably clear, and there was no indication of a recurrence of the growth. The fundus was normal.

One year later the patient discovered an enlargement in front of the left ear and he was advised to return for observation. The condition then was as follows:

Marked drooping of the upper lid with

a few lashes which had not been epilated. The pannus returned, and encroaching on the lower fifth of the cornea from each side of the medial line, there was a pterygium like growth of the conjunctiva. The lower lid was adherent to the globe, and at the site of the original growth there could be felt a slight elevation about the size of a large grain of

case confidently expecting a return of the original growth and a metastasis, but he was seen April, 1920, over six years after the first operation, and the eye was quiet except for the complication of a chronic trachoma.

As the original growth had been so readily removed, I had doubted the correctness of my diagnosis, and as I did

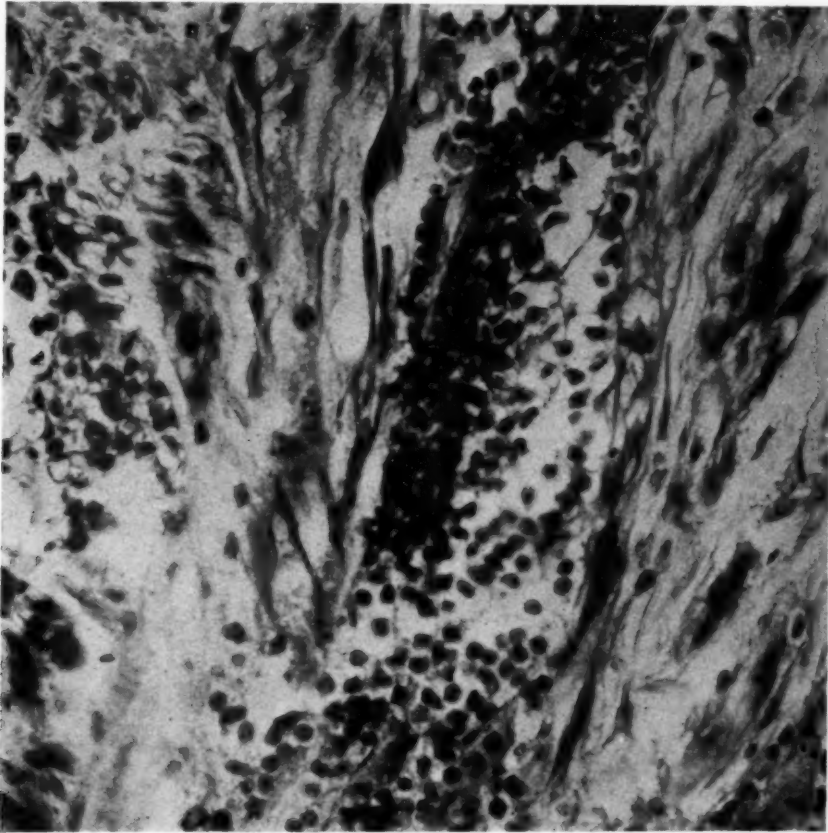


Fig. 3.—High magnification of Fig. 2, showing especially mucoid degeneration of connective tissue stroma.

rice. Situated beneath the skin in front of the tragus of the left ear was a movable gland.

I again urged an enucleation to which the patient refused, and he was content with the removal of the recurrent growth and gland, both of which were done under local anesthesia. The wounds healed nicely and shortly afterwards he was dismissed.

I have kept close observation of the

not wish to risk solely my opinion and that of the pathologist as to its malignancy, I had sent sections to three other pathologists of wider experience, all of whom unhesitatingly concurred in the same diagnosis. The report of Dr. Geo. S. Dixon was in part as follows:

"The sections show an alveolar stroma of connective tissue filled with epithelial cells of the basal variety after the manner of true carcinoma. The connective tissue

has undergone mucoid degeneration to a considerable extent, and where this has not occurred the stroma holds a fair number of small round and lymphoid cells. Vessels are not very numerous, and there is some epithelial degeneration within the alveoli.

Diagnosis: Carcinoma myxomatoides.

The recurrent tissue shows the same

mm. Of course the preauricular gland is normally very small, but there are so few lymphoid cell remaining in this specimen (and they are just under the capsule) that it seems evident a considerable number have been absorbed. Practically the entire tumor is carcinomatous, and of the same character as the tumor of the lid without its degeneration. The

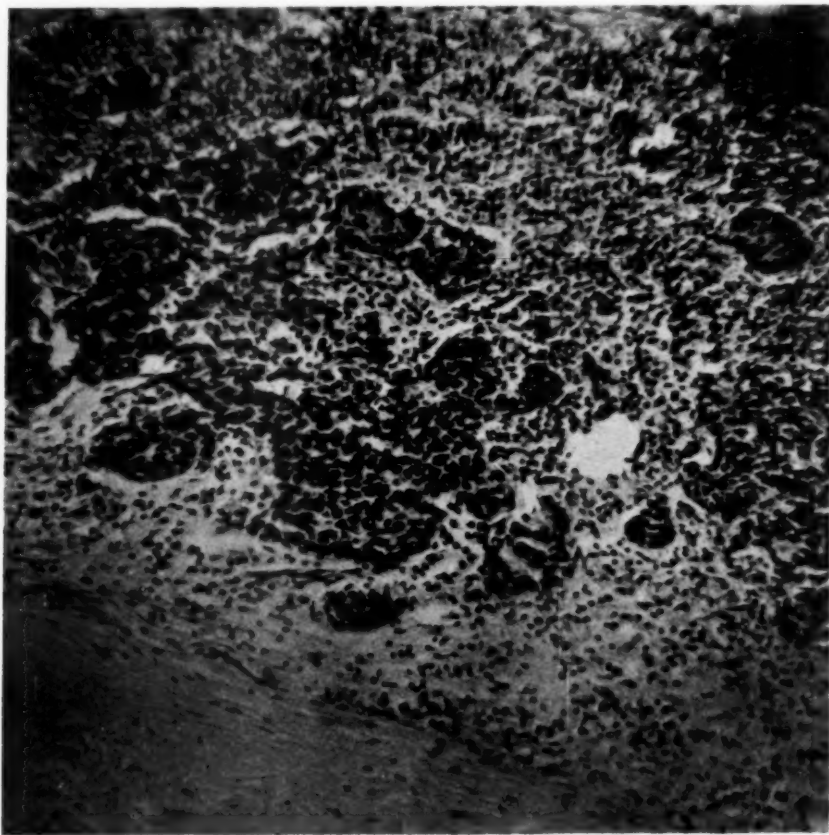


Fig. 4.—Section of recurrent growth in lid intimate with sclera, a fragment of which is seen.

general characteristics, but without the mucoid degeneration of the connective tissue stroma, more irritation and less epithelial degeneration possibly owing to being a younger growth than the original,—given the same time the same degeneration would doubtless occur. There is a small amount of scleral tissue attached to one border of this growth.

The preauricular gland is a metastatic growth. It measured $9.5 \times 11.5 \times 12.5$

cells here are younger, densely packed in the alveoli and in very good condition as compared with those of the other two specimens. The connective tissue stroma is rather scanty."

The clinical diagnosis of primary epibulbar carcinoma was confirmed by pathologic examination and more than likely its origin was in the conjunctiva at the limbus, for as is well known where one kind of epithelium passes into an-

other, as such is the case in the epithelium of the cornea and conjunctiva, it is a favorite site for epitheliomatous growths. A pterygium operation antedating the growth of the tumor by about two years and the irritation of the globe from ingrowing cilia, may have had their influence in the development of the neoplasm.

tion occurred in 20 cases or 37.7 per cent. When the globe is invaded it is along the perivascular and perineural lymph spaces of the corneo-sclerotic junction, never elsewhere, says Parsons.

The proper surgical procedure in any case of epibulbar carcinoma is to me always a matter of grave concern, and the dictum of de Schweinitz is one worth

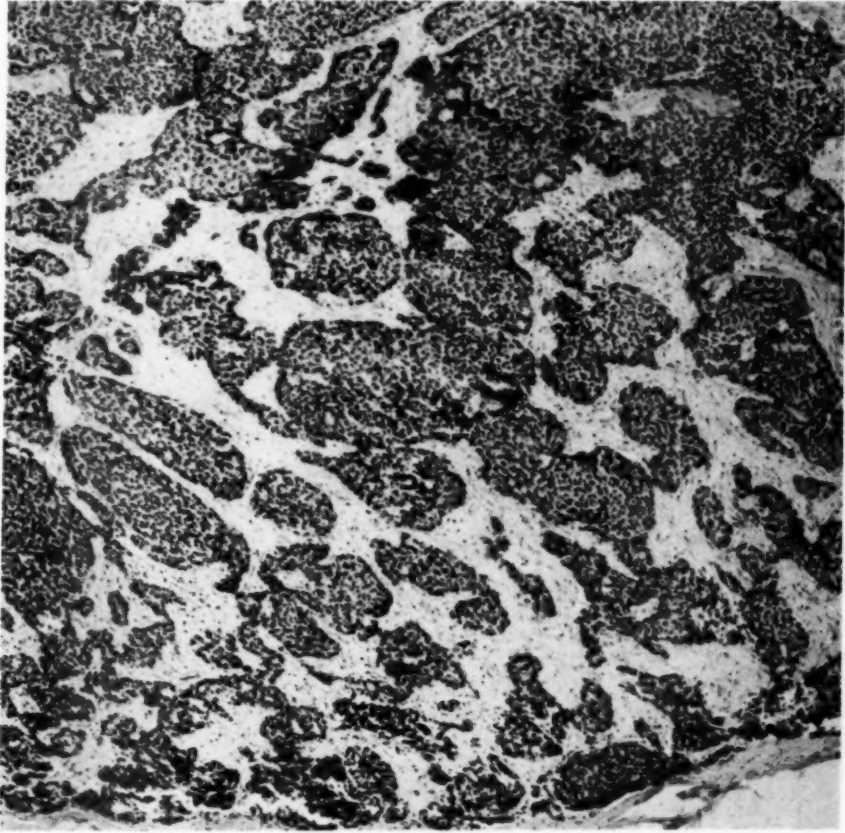


Fig. 5.—Section of tumor of preauricular gland, which is entirely carcinomatous. Low power.

As to the question of the invasion of the globe, many authors are at variance in their views, as for instance, Axenfeld, Greeff and Saemisch believe the eyeball is rarely penetrated, while a contrary opinion is expressed by Parsons and de Schweinitz. The latter proved that perforation does take place in a considerable number of cases, especially if the growth was of long duration, for he showed that in 53 reported cases perfora-

remembering: that is, if the growth is small and situated at the limbus, a deep excision may be made but the case closely watched for developments. Whereas a larger growth further removed from the limbus may be excised with greater safety, as it is further away from the penetrating ciliary vessels.

While a lymphatic glandular involvement is not a common occurrence (the preauricular first affected and later the

submaxillary), it is usually regarded as an indication for an enucleation or a more radical operation in the orbit.

A point of interest in this and other cases is the slowness with which these malignant tumors develop. Irritation from cauterization or palliative surgery apparently excites their growth.

In regard to the treatment with radium

of new cells as well as the clearing up of the cornea which temporarily gave better vision.

My experience in this one case has led me to draw the following conclusions:

(1) Conservative surgery is indicated when the epibulbar growth is remote from the limbus, even tho it may be large.

(2) A preauricular glandular enlarge-

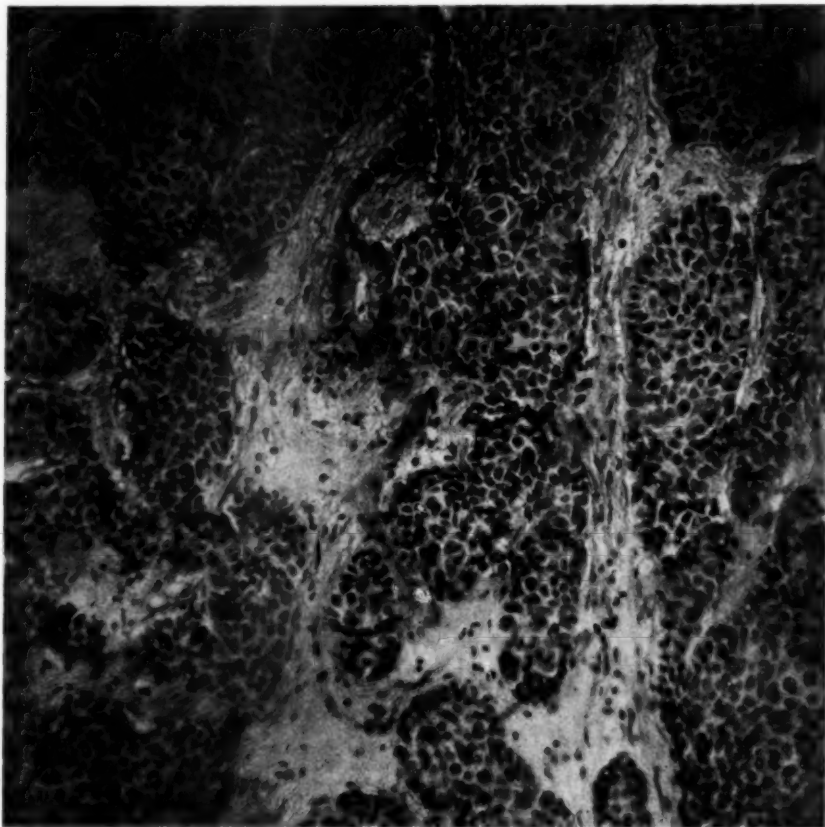


Fig. 6.—High magnification of Fig. 5. The cells are young and densely packed.

of carcinomatous areas of the lid after the excision of the growth, it is now a procedure often employed. While the end results of treatment in this case have been satisfactory, radium may have had its influence in arresting the development

ment is not a serious complication as long as the lid tissues are not breaking down.

(3) Radium or other similar rays may be of value as an agent against recurrence when used early after the operation.

THE TARSUS MADE PLIABLE AS A CURE FOR TRACHOMA.

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This technic aims to soften the infiltrated tarsus as seen in trachoma. The writer claims as good results as when the tarsus is extirpated.

This illustrated article of a technic of mine, for the treatment of trachoma, is submitted for the reason that it appears correct in principle, is based upon reasonable deduction and has given most satisfactory results. In principle it is correct for it does not produce more scar tissue as a means to a cure, in what is already a scar tissue producing disease. It does not adopt destructive caustics and such mechanical means that scrape, scarify and

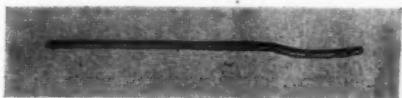


Fig. 1.—Rod, made from street car trolley wire, bent at one end

destroy the epithelium; but to the contrary its aim is to obviate the production of scar tissue with its mutilating effect. It does not accept that we are justified in imitating nature's curative process by the laying down of contractile tissue.

The deduction is drawn from a consideration of the disease histologically, pathologically and from the physiologic changes produced by the treatment. The disease is a folliculosis with an infiltration of the deeper tissues; and the degree of this infiltration lends itself as a differentiating factor between trachoma and follicular conjunctivitis, for in trachoma the infiltration is greater. The importance of this infiltration, particularly that of the tarsus, is stressed for it obtains in the trachomatous process to an extent that is not usually taken cognizance of; and if treated, according to the suggested technic, demonstrates to what measure this fibroelastic tissue was involved.

This tarsal pathology is to be noted early in the disease and the ptosis so commonly observed is thus explained. The operation of Heisrath and Kuhnt which is an excision of the tarsus, aims to rid the eye of this infiltrated tissue; and we obtain very favorable reports from those

adopting it. The treatment advocated by me is to make pliable this infiltrated tarsus obtaining the same beneficial effect without being compelled to remove it. It offers the advantage that while making it pliable you expel the contents of the follicles and produce other changes that

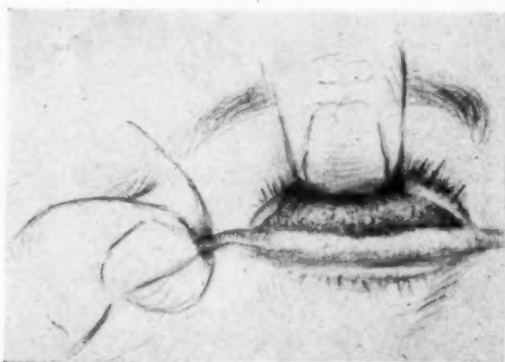


Fig. 2.—Cotton wrapped rod under everted tarsus, pressure made up towards thumb, and rod rotated.

are to be desired. During the treatment an ischemia with its subsequent hyperemia is produced, which is unquestionably followed by an increased leucocytosis. The infiltrated tarsus is depleted.

Before the suggested manipulations are undertaken all possible care is given to the preparation of the patient. The secretion which is very commonly noted is best explained as the result of a chance infection, and is to be treated for days and cleared up before proceeding. This chance infection is to be studied microscopically. When rigid cleanliness and antiseptic treatment is adopted it is surprising how rapidly it will improve. A warning is to be sounded not to use the albuminous silver preparations in treating and preparing the patient, for you may permanently stain the cornea and conjunctiva. It appears that in trachoma these tissues are readily stained. That the secretion is improved by treatment is quite evident and it is not essential for the clinical syndrome.

Mercurochrome is most helpful in clearing up this secretion. The eye is immersed in a one-half of one per cent aqueous solution, three or more times daily; or a zinc solution is used with great advantage. The patient is prepared in the usual surgical manner and the whole procedure is carried out with reasonable precaution in protecting against infection. Much of the long delay in obtaining results after these different mechanical technics is due to neglect of these precautions.

This suggested mechanical treatment demands but a single sitting and general anesthesia is required. Good results are

so that it may be easily inserted under the everted tarsus. The lid is everted and the cotton wrapped probe which is dipped in sterile water, is inserted under the tarsus and with the thumb holding the lid everted pressure is made with the cotton wrapped probe up towards the thumb and the thumb is pressed towards the probe causing the tarsus to bend and at the same time the probe is rotated. This manipulation presses out the contents of the follicles and depletes the infiltration.

You may repeat the manipulations a number of times, making certain that all follicles are emptied, and repeating the



Fig. 3.—Removing all follicular contents.

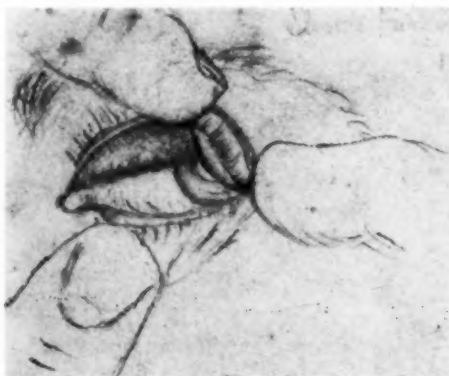


Fig. 4.—Method of rolling the lid to keep tarsus pliable.

to be accomplished with local anesthesia, but demands more than one sitting as it does not offer an opportunity for completeness. Many who have adopted the repeated treatments under local anesthesia claim for it an advantage, for by compulsion it is more gentle and it repeats the improvement obtained by repeating the ischemia and hyperemia which is greatly desired. It is immaterial which method you adopt for from either you will obtain gratifying results.

METHOD OF PROCEDURE.

This is shown in Fig. 1. A heavy piece of copper wire, of the size used for street car cable, with a length of about eight inches is bent slightly about two inches from the end. The rod is wrapped evenly and carefully with cotton for the distance of the bent portion and only sufficient cotton is used as a wrapping

benefit obtained by the leucocytosis produced. The tarsus which at first was indurated becomes pliable, and it is with ease that you can now manipulate it. It is softened and might be compared to a piece of wet leather for it is easily bent and can be turned in many directions. The manipulations are done gently and the probe is not to injure or destroy the epithelium.

Fig. 3 shows to what extent the conjunctiva and tarsus may be squeezed. Fig. 4 gives a method for keeping the tarsus pliable.

IN CONCLUSION—This technic of mine does not destroy or injure the epithelium. It does not produce scar tissue. It depletes an indurated tarsus, making it soft and pliable; and accomplishes results as if the tarsus had been removed; and more it expresses the follicles and stimulates a leucocytosis.

THERMOPHORE STUDIES IN GLAUCOMA

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Effects previously observed suggested the thermophore might produce experimental glaucoma. These experiments show that in the rabbit it furnished a method of reducing intraocular tension instead of increasing it. Its trial on the human eye in two cases of glaucoma indicated that it offered marked possibilities in the effective treatment of that disease. Presented at the Section on Ophthalmology of the American Medical Association April, 1920. Published here by courtesy of the JOURNAL of the A. M. A.

The original series of studies on the effects of heat on the eye, was directed toward a method of improving our present means of treating hypopyon keratitis, serpiginous ulcer of the cornea. During the period of experimen-

about the same changes as 130 F. applied for ten minutes, and in the spring of 1919 we undertook a series of experiments for working out this idea.

The prolonged exposure required in these investigations rendered unsuit-

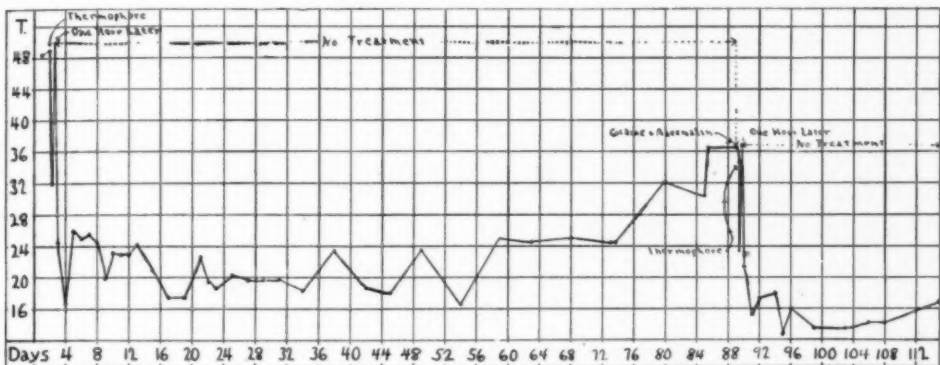


Chart 1 (Case 2).—In this case the tonometric readings were made only after the use of holocain and after the thermophore application, so that the cocain-epinephrin reaction, of which we were at that time unaware, is not shown. The drop from 49 to 32 is probably this reaction and not due to the immediate effect of the heat. The rebound, however, is shown by the steep jump from 32 to 50 within one hour of the application. The deep drop from 50 to 16.5 during the next two days without any treatment shows the thermophore reaction. There is a long period of oscillation within normal limits until the eightieth day, when the tension rises to 32 and to 36.5 by the eighty-ninth day. Here a slight cocain-epinephrin reaction is shown with a deep drop to 23.5 and a rebound to 37 within an hour, with the thermophore drop to 12.5 within the next four days, and a slow tendency to rise. The case is still under observation without treatment, and we are awaiting with interest its future tonometric history.

tation, clinical application and routine use of the technic finally evolved, a number of collateral issues came up, some of which promise to equal or surpass in importance the original work. Among these is the effect of heat on normal and pathologic intraocular tension.

It was early noted that when 130 F. was conducted for ten minutes into the anterior chamber of a rabbit's eye thru the cornea, an atrophy of iris tissues with thickening of the base of the iris and occlusion of the filtration angle occurred. This suggested the possibility of producing an experimental glaucoma. We found that 140 F. applied for five minutes would induce

able the simplified thermophore used in treating ulcers. Accordingly, we had recourse to a more complicated electrically heated instrument, with automatic thermostat control.

This instrument has been developed until it is now in a substantial and practical form, always available and rarely out of order. It will suffice to say here that by means of it, short nickel-plated brass rods can be raised to any desired temperature and held constantly at this temperature for any length of time. These rods we have termed "conductors," their purpose being the storage of heat and its conduction into the tissues. The ends of these rods are turned down to various sizes

or dressed into different shapes, usually flat and circular, but sometimes concave and sometimes rectangular or cone shaped. All these ends are intended to be placed in actual direct contact with the tissues into which the heat is to be conducted. Hence we have termed them "contact surfaces." For anesthesia, we used these solutions:

1. Holocain, $1\frac{1}{4}$ grains; distilled

Our scheme now was to apply this contact surface to the cornea opposite the root of the iris for five minutes at 140 F.; then wait until the reaction from this application had subsided and then to apply it again alongside the site of the first application; then to repeat the process until the entire root of the iris had been acted on. Detailed history follows:

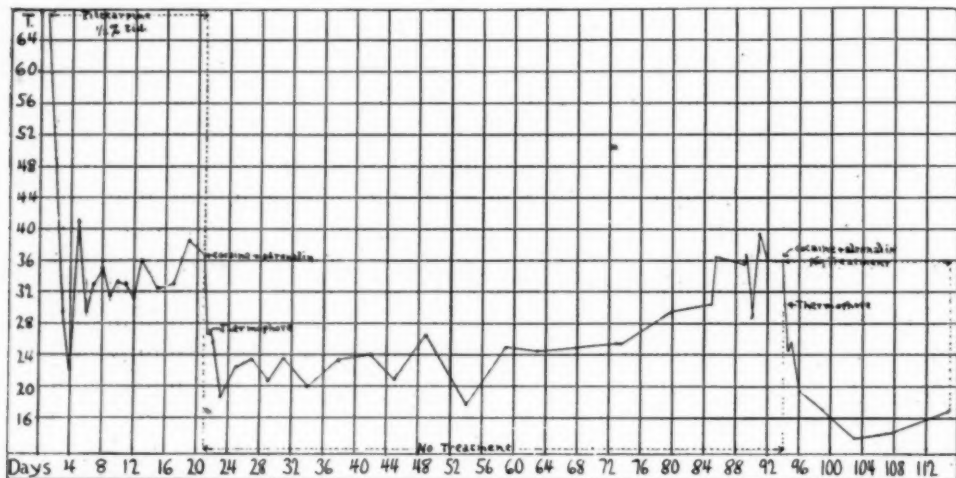


Chart 2 (Case 2).—This chart shows a steep drop from 67 to 22 under pilocarpin hydrochlorid in three days, then a rebound under this treatment, and then oscillation at a rather high mean level until the twentieth day, when the thermophore technic was applied. Cocain-epinephrin reduced the tension from 36.5 to 26.5, and the thermophore reaction carried it on down to 18.5 within the next two days. The rebound is not shown here because we had not been sufficiently impressed by it to be on the lookout for it, and the tension was not taken after the thermophore application until the next day. There then followed a period of oscillation at a much lower mean level than the pilocarpin produced, until about the eightieth day, when a rather rapid rise began. On the ninety-fourth day the thermophore technic was again applied, with a rapid lowering of tension without any treatment on succeeding days. The rebound is also not shown here for the same reason as above. It may be significant in the matter of prognosis to note that in both cases after the second heating the tension dropped to a lower level than after the first heating. The case is still under observation.

water, 2 drams; referred to as holocain, 1 per cent.

2. Cocain, 6 grains; epinephrin (adrenalin) 1:1,000, one-half dram; distilled water, sufficient to make 2 drams; referred to as cocain-epinephrin solution.

3. Cocain, 6 grains; distilled water, 2 drams; referred to as cocain, 5 per cent.

In our clinical work with glaucomatous eyes we found considerable variations in the effects of the last two solutions.

We constructed a conductor with a curved contact surface 2 by 4 mm. for applying the heat parallel to the limbus and opposite the root of the iris.

REPORT OF EXPERIMENTS.

EXPERIMENT 1.—Rabbit 7, small, tan; cocain-epinephrin anesthesia. Application to O. D.; O. S. retained as control.

June 4, 1919, application to O. D. as above described. Transient myosis (against cocain mydriases). Destruction of epithelium and clouding of Bowman's membrane at site of application. Hyperemia of adjacent conjunctiva.

June 9, epithelium replaced, cornea clearing. Iris turning gray opposite site of application. (Note appearance of iris atrophy five days after treatment. In our subsequent clinical applications we found it much more dif-

July, '19

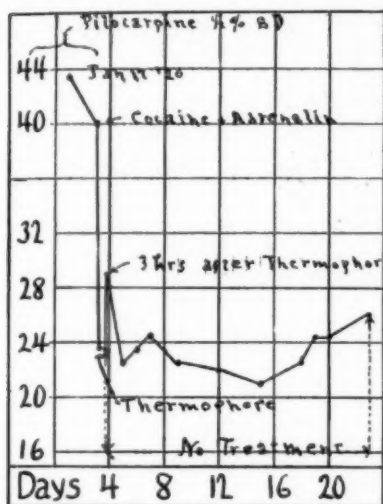


Chart 3 (Case 3, Mrs. S. T., left eye).—This case had been treated for about six months with pilocarpin, 0.5 per cent, twice a day, with a tension oscillating above 40. The cocain-epinephrin reaction brought it from 40 to 23.5 within the usual time (from twenty-five to thirty minutes.) After three hours there was still some of the rebound, the tension being 29. On subsequent days there was an oscillation at a low level, with a slow tendency to rise. The case is still under observation.

difficult to produce this atrophy in the human eye.) Iris somewhat drawn toward site of heated area (in this instance upward).

June 11, eye quiet. Iris gray opposite application of June 4. Applied thermophore 140 F. five minutes to upper inner quadrant. On this date we began attempting to measure the tension by means of the Schiötz type, and a balastic spring type of tonometer. Our readings varied so widely that we gave up the attempt for the time being as futile.

June 16, another application.

July 11, no evidence of rising tension. Treated eye feels softer than the opposite (control) eye.

August 29, two applications at different sites.

September 15, final application. We had now completed the ring around the cornea parallel to the limbus as nearly as we could get it tho some of the applications were rather far out on the cornea.

September 29, reaction not yet sub-

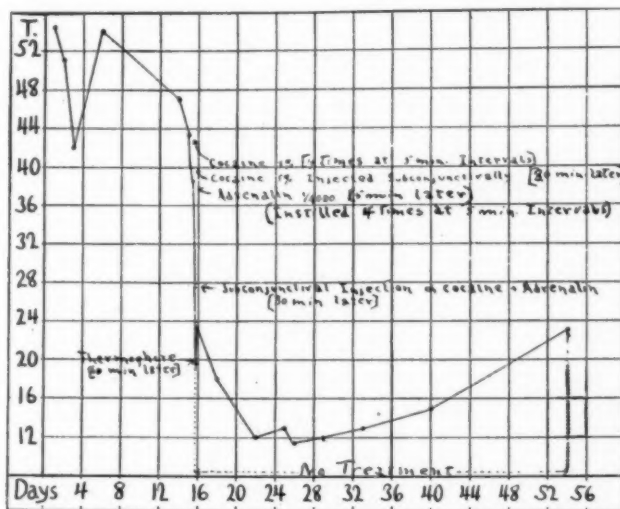


Chart 4 (Case 4, Mrs. L. H., left eye).—This shows the effect of cocaine used alone and then followed by epinephrin and epinephrin-cocain on glaucomatous eyes. Tension after holocain was 43.5. Then cocaine, 5 per cent, was instilled at five minute intervals until four instillations had been made. Ten minutes after the last instillation (thirty minutes after the initial instillation) the tension was 40, a very slight fall. About 2 minims cocaine, 0.5 per cent, were now injected subconjunctivally, and five minutes later the tension again taken; it was 38.5. This was a drop of only 5 points. Epinephrin solution, 1:4,000, was then used four times at five minute intervals, and ten minutes after the last instillation, tension was 27.5. A subconjunctival injection of about 2 minims of cocaine-epinephrine solution was now made, and ten minutes after this the tension was 20. This series of observations seems to indicate that epinephrin acts as a powerful adjuvant to the tension-reducing power of cocaine in glaucomatous eyes. The thermophore was used at this point, and a slight rebound shows. The usual period of low tension with a gradual tendency to rise followed.

sided. Eye feels definitely softer than O. S. During this time we had been studying the causes of failure to get dependable tonometric readings and found that if we placed the rabbit within a small sack just deep enough and wide enough to hold it tightly and to allow its head to stick out, then, with the eyes thoroly anesthetized, lay it over on its side and hold it firmly, we could get satisfactory measurements. It was necessary to observe the further precaution of opening the lids

clouding of anterior capsule of lens opposite this area. Pupil O. D. somewhat smaller than pupil O. S. and slightly irregular. Ophthalmoscope, O. D., shows that some of the gray areas in the iris are decidedly translucent. Disc and details of fundus appear normal. All inflammatory symptoms gone.

We find, therefore, that instead of producing a glaucomatous eye, we produced one with an abnormally low tension which persisted after all inflammation had subsided, and all changes

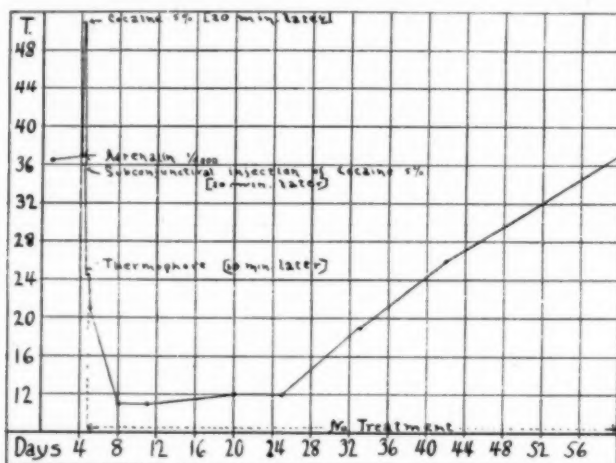


Chart 5 (Case 8, Mrs. S. J. B., right eye).—This is to show the effect of epinephrin when used alone on a glaucomatous eye, and when combined with cocaine. For the first four days of observation the tension was just above 36. On the fourth day after holocain, the tension was 37. Epinephrin, 1:4,000, was then instilled three times at five minute intervals. Then five minutes after the last instillation the tension was 51, a rise of 15 points. Cocain, 5 per cent, was then instilled three times at five minute intervals, and five minutes after the last instillation the tension had again fallen to 36. About 2 minims of cocain-epinephrin were then injected subconjunctivally, and ten minutes afterward the tension was 24.5. This seems to indicate that epinephrin used on a glaucomatous eye raises the tension, which promptly falls when cocain is added, and is still further reduced by the combination of cocain and epinephrin. The thermophore was applied at this point. The tension was not taken an hour afterward, so that the rebound does not appear on the chart. Subsequent days showed marked low tension, with a steady rise after the twenty-fifth day.

slowly and gently, being very careful not to exert any pressure on the globe with our fingers.

All readings noted below were taken by one of two Schiötz tonometers that we were using, the usual checking precautions being constantly observed:

D=DEFLECTION; T=TENSION

Oct. 6, O. D. with 5.5 gm. wgt., D=10, T=8 mm. Hg
O. S. with 7.5 gm. wgt., D=6, T=22 mm. Hg
Oct. 27, O. D. with 5.5 gm. wgt., D=11, T=7 mm. Hg
O. S. with 5.5 gm. wgt., D=4, T=21 mm. Hg
Nov. 3, O. D. with 5.5 gm. wgt., D=10, T=8 mm. Hg
O. S. with 5.5 gm. wgt., D=3, T=25 mm. Hg

November 3, irregular circle of gray entirely around iris O. D. Cornea slightly nebulous below, where application was made far out on it, and slight

seemed to have ceased. The eye was enucleated, Nov. 3, 1919, for microscopic examination. Being now confident of our tonometric readings, we decided to follow this up by a study of the effect of a single application of heat 140 F. for five minutes, using a conductor with a circular contact surface 4.5 mm. in diameter.

We made this experiment a number of times, of which the following is fairly typical:

EXPERIMENT 2.—Rabbit 19, brown; Oct. 8, 1919; cocain-epinephrin anesthesia O. D. and O. S.

O. D. with 7.5 gm. wgt., D=7.5, T=17
O. S. with 7.5 gm. wgt., D=7.5, T=17

Applied 140 F. for five minutes with 4.5 mm. contact surface to O. D. astride limbus. Corneal epithelium destroyed but replaced in two or three days. Some clouding of Bowman's membrane and hyperemia of conjunctiva, all of which gradually cleared up.

TONOMETRIC HISTORY AFTER TREATING.

	O.D.	O.S.
October 8.....	10	17
October 10.....	8	17
October 13.....	8	17
October 17.....	8	18
October 20.....	15	17
October 22.....	15	19
October 27.....	19	21
October 31.....	22	22
November 5.....	22	22
November 14.....	19.5	22

This shows a sharp drop in tension and then a slow recovery to normal during about three weeks, without any ill effects remaining. We varied this experiment in several ways. For instance:

EXPERIMENT 3.—Rabbit 25, large, white and black; under general anesthesia (ether), applied 145 F. with contact surface 4.5 mm. in diameter for five minutes to O. D., after which tonometer gave:

	O.D.	O.S.
January 14.....	12.5	12.5 (before heating)
	12.5	12.5 (after heating)
January 19.....	7.5	18
February 11.....	19	19

which indicates that the drop in tension is not caused by the local anesthetic.

Occasionally after cocain anesthesia without epinephrin we got a transient increase in tension. For instance, on Rabbit 21, Jan. 5, 1920, $T=20$. Then cocain 4 per cent. was instilled, and 150 F. was applied for five minutes with 4.5 mm. contact surface, after which:

O. S. with 5.5 gm. wgt.,	$D=1$, $T=35.5$
7.5 gm. wgt.,	$D=3$, $T=36.5$
10 gm. wgt.,	$D=5$, $T=38$

After eight minutes, tension had dropped to 26. This elevation in tension did not always occur when cocain alone was used. By January 9, tension had slowly dropped to 6 mm. of mercury, and by January 19 had risen to 11.5 mm. of mercury.

Experiments were also conducted to determine the ideal situation for the application. This seemed to be astride the limbus, two-thirds of the contact surface being opposed to the sclera,

and one-third to the cornea. If applied lower on the cornea, the reaction was more intense and the tension not more reduced, nor did it remain low for a longer period. If applied farther back on the sclera, the tension did not drop at once; and when it did go down, usually after twenty-four hours, it never went so low, nor remained down so long, as if applied astride the limbus.

A temperature of 140 F. for five minutes was chosen because lower temperatures and shorter exposures produced less marked and more transient results. A temperature of 150 F. and above applied over the sclera caused permanent changes in the choroid and retina. After application of 160 F. for five minutes, the sclera at the point heated was so weakened that if the eye was excised at once and opened and the sclera rubbed briskly between the thumb and forefinger, a hole corresponding to the heated area was quickly worn thru.

In the early experiments, a circular contact surface 4.5 mm. in diameter was employed. Later, a surface 4 by 7 mm., with a concavity corresponding to the curvature of the sclera, was used.

As no damage to any of the eyes of rabbits treated in the manner described was made out, except in the first case, in which excessive applications were made, it was decided to determine what would be the effects on glaucomatous eyes in man.

REPORT OF CASES.

CASE 1.—The right eye of an old man had been blind and painful for four years with glaucoma. The tension was 67 (Schiötz). There was practically no anterior chamber, the iris being pushed forward by a greatly swollen cataractous lens. The tension was taken after three instillations of holocain, 1 per cent, at three minute intervals. Then the eye was further anesthetized with cocain, 5 per cent, and epinephrin, 1:4,000, after which the thermophore with 4.5 mm. contact surface was applied at 135 F. for three and one-half minutes at the upper limbus. As the patient complained of pain, the

treatment was discontinued. The tension was taken immediately and was 58 (Schiötz).

On his return, next day, the patient said that his eye had never been so comfortable in the past four years. The epithelium over the heated area was desquamated, so that tension was not taken; but the eye felt as hard as before the heating. There was slight blanching at the area heated, while the remainder of the eye was rather red and there was swelling of the conjunctiva.

ored, presented himself complaining of failing vision in each eye. Sight began to fail in the left eye ten months previously, and in the right eye within the last two months. The vision was: O. D., 10/250; O. S., P. L. The media were perfectly clear and there was marked cupping of each disc with atrophy of the left. The patient had never had treatment for his eyes except some internal medication. The tension was:

O. D. with 10 gm. wgt., = 65 Schiötz
O. D. with 15 gm. wgt., = 70 Schiötz
O. S. with 10 gm. wgt., = 47 Schiötz
O. S. with 15 gm. wgt., = 45 Schiötz

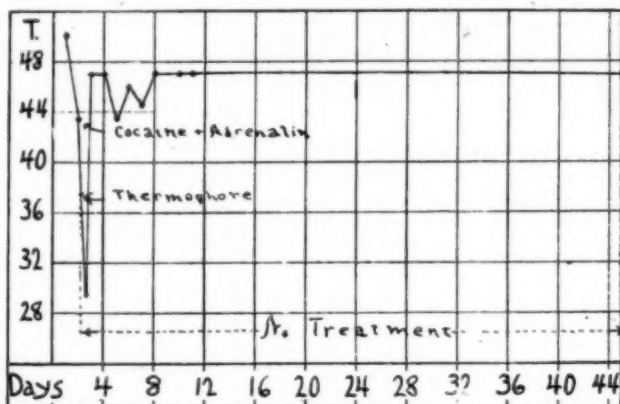


Chart 6 (Case 9, Mrs. G. C., left eye).—This chart illustrates the cases that we must so far class as failures. It was a case of advanced glaucoma with swollen cataractous lens and extremely shallow anterior chamber. There is a rather marked cocaine-epinephrin reaction and a further drop after the thermophore from 43.5 to 29.5, probably a continuation of the cocaine-epinephrin reaction. By the next day the tension had returned to 47, and it remained there day after day. There was, however, no injury to the eye from the thermophore treatment.

The next day most of the reaction had subsided, but tension was 65 (Schiötz).

One week later, the tension still being 65, another heating was done. This time the same contact surface was used, but the temperature was increased to 140 F. and the application to five minutes. No reduction of tension followed.

Two days later the tension was taken for the last time and found to be 57-60 (Schiötz). This was only about 8 points lower than before the first treatment. The patient was lost sight of, and the case must be regarded as a failure.

CASE 2.—Oct. 18, 1919, the day after the first heating of the patient described above, Elijah C., aged 66, col-

October 19, the tension was: O. D., 52; O. S., 46. Application was made astride the limbus in the upper quadrant 4.5 mm. circular contact surface to the left eye (Chart 1). The exposure was for five minutes at 140 F.; cocain, 5 per cent, combined with epinephrin, 1:4,000, was used freely in the eye before the treatment. The tension immediately after heating was found to be 32, a drop of 14 points. One hour later the tension had risen to 49. The patient experienced no pain during the heating. Pilocarpin, 1/240 grain every three hours, was ordered for the right eye.

The following day the right pupil was contracted to 1.5 mm. (pilocarpin). The left eye showed a gray area where heated. The vessels were not

destroyed, and the corneal epithelium was replaced. The pigment under the area heated was either obliterated or destroyed. There was a moderate amount of general redness and chemosis of the conjunctiva. The pupil was about 4.5 mm. in diameter and was pear shaped, being drawn up toward the point heated. The tension in the right eye averaged 30, and in the left, 25. This was a fall of 21 points in the treated eye. The vision in the right eye had increased to 20/60, and in the left to 1/75 eccentric.

November 7, the tension of the right eye after using holocain, 1 per cent, three times at three minute intervals was:

O. D. with 7.5 gm. wgt., D = 3, T = 36
O. D. with 10 gm. wgt., D = 5, T = 37.5

After this, cocain, 5 per cent, combined with epinephrin, 1:4,000, was used freely in the eye and 2 minims were injected subconjunctivally near the limbus. Ten minutes later the tension was again taken and an average was found to be 26.5, a drop of about 10 points.

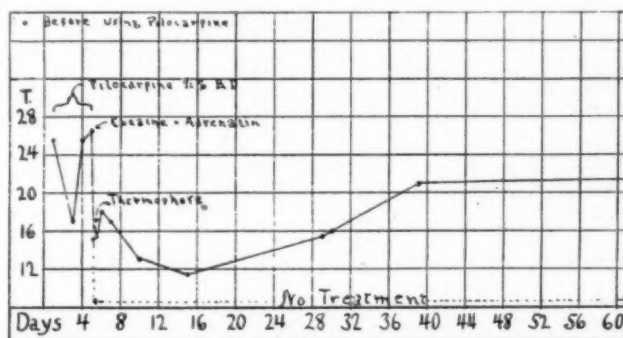


Chart 7 (Case 5, Mr. W. S., left eye).—This case is the only one in which we obtained a visible (the slight) atrophy of the iris opposite the point heated. There is a rather marked cocain-epinephrin reaction and a period of unusually low tension followed by a slow rise to 21. The rebound was not measured.

A further drop in tension was noted on the next day, O. D. measuring 22 and O. S., 16. The media were perfectly clear.

Pilocarpin was omitted in the right eye for twenty-four hours, and the tension rose to 41. The corresponding tension in the left eye, October 22, was 26. The pupil had almost resumed its normal shape, but still remained slightly drawn up. The eye otherwise was practically normal except for a persistence of the blanching in the heated area and a slight general redness.

For nineteen days after the application the condition remained about as above. The tension in the right eye varied under pilocarpin every three hours from 30 to 37; that in the left, without any treatment, from 16 to 26. No atrophy of the iris was evident. After the initial improvement in vision there was practically no change.

This was a reaction which we had found previously and concerning which our experiments—including later in this article—indicate that the reduction is due to the combination of drugs more than to the action of either one alone.

Then application of thermophore with 4.5 mm. contact surface at 140 F. for five minutes to upper part of sclera bordering on the limbus was made (Chart 2). The patient experienced no pain.

The conjunctiva appeared slightly thinned; the blood vessels were intact; a very small area of the corneal epithelium was touched. After application, holocain, 1 per cent, was used. The tension was then taken and found to be the same as just previous to the treatment.

November 8, both eyes were reported comfortable. The tension in the right eye was 25-26, and in the left eye, 18-21. No pilocarpin had been

used in the preceding twenty-four hours. The right eye showed in every particular the changes previously noted in the left eye. The vision was slightly lowered (from 20/48 to 20/6) for one day, but this soon returned to 20/48.

For two months there was practically no change in either eye. The tension ranged from 17 to 26. No drugs were used in either eye, except holocain on the days when the tension was taken.

Jan. 5, 1920, the patient returned after an absence of one week with a

January 19, the cocain-epinephrin reaction in the right eye showed a fall from 36 to 30, and an application similar to the one in the left eye was made. The tension immediately afterward was 25.

January 20, the tensions were: O. D., 25; O. S., 14. The usual general ocular reaction was present.

January 21, the tensions were: O. D., 20; O. S., 16. The vision was: O. D., 20/38; O. S., 1/75 eccentric.

February 16, the tension was 22 in each eye.

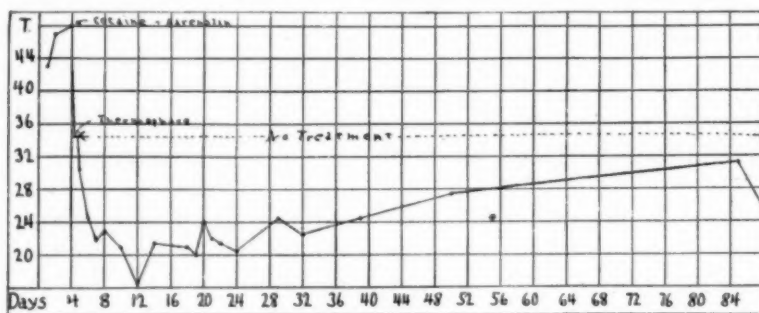


Chart 8 (Case 7, Mrs. P. E. W., right eye).—This patient had had no previous treatment. There is a marked cocain-epinephrin reaction and a further marked thermophore reaction to a minimum of 16.5 from a maximum of 48; then the usual slow tendency to rise. She will probably require a second application. The rebound was not measured.

tension of 30 in each eye. This rose gradually during the next week to 35, at which time, January 14, the cocain-epinephrin reaction was tried with no change in tension. The left eye was at once heated to 140 F. for five minutes with 4 by 7 mm. contact surface, adjacent to the area formerly heated.

The tension immediately after heating was:

O. S. with 5.5 gm. wgt., D = 3, T = 25
 O. S. with 7.5 gm. wgt., D = 5, T = 26
 O. S. with 10 gm. wgt., D = 7.5, T = 25

Pupil O. S., 8 mm. in diameter; pupil O. D., 4.5 mm. in diameter. One hour later the tension O. S. had returned to 36.

January 15, tension O. S. had dropped to 21 and there was a drop in right eye also to 29.

The left pupil was slightly drawn up, and other observations were similar to those noted at the former heating.

January 16, tension O. D. was 39, and O. S., 15.

The visual fields taken from time to time showed no change thruout the treatment.

CLASSIFICATION OF CASES.

Our cases fall into two groups, of which the two foregoing cases are examples, one of each group. In the one group in which the glaucoma is no longer simple—that is to say, in which there is a swollen lens and very shallow anterior chamber, with almost certain obliteration of the filtration angle—the heating produces little, if any, reduction in tension. However, it may be noted that in most of our cases of this sort in which there was an acute attack of pain, the pain was relieved within forty-eight hours by the application.

In the other group are the simple cases which have not progressed to marked secondary changes. In these there is an early fall of tension, usually to nearly normal within forty-

eight hours, followed by a long period—the longest thus far being two and one-half months—of low tension, during which time the patient uses no drugs and has the benefit of a wide pupil. Then there comes a return of increased tension, which has responded readily to a reapplication of heat. How long the tension will remain low after repeated heatings, we do not as yet know. In the rabbit, after four or five heatings the tension remained permanently low. This was a permanent subnormal.

In order to give a comprehensive view of the tonometric history of the cases treated, a series of nine charts is shown. These comprise the most important variations we have observed in the thirty-two eyes treated to date. ROUTINE PROCEDURE IN PROCURING DATA.

1. Instil holocain, 1 per cent, two or three times.

2. Take tonometric readings.

3. Instil cocain-epinephrin solution three times at five minute intervals, then inject subconjunctivally about 2 minims of the cocain, 5 per cent-epine-

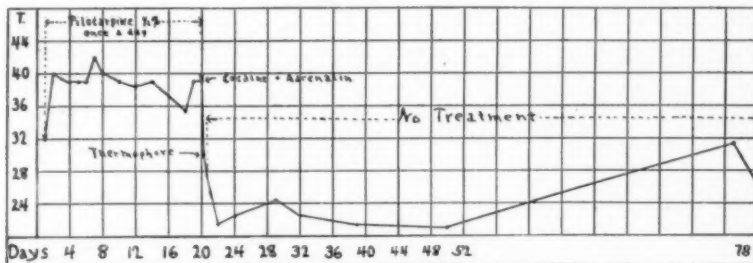


Chart 9 (Case 7).—This shows a rather marked cocain-epinephrin reaction and a tension level much lower after the thermophore without further treatment than the tension level before the thermophore with rather insufficient instillations of pilocarpin. The rebound was not measured.

A further point of importance is the possibility of reducing the tension to normal when it has been impossible to do this with pilocarpin, 0.5 per cent solution, used as often as every three hours.

Early in our work it seemed wise to test the effect of the drugs which we were using on the tension. We found that epinephrin, 1:4,000, alone, usually caused a rise in tension; cocain, 5 per cent, alone, produced some fall; but when combined with epinephrin, 1:4,000, it produced in most cases a much more decided fall in tension which lasted about an hour. This fall was not universal and seemed to take place in almost the same type of cases in which the heat application induced a lower tension. In the type of cases with swollen cataractous lenses, the tension was not much reduced; and in one case of glaucoma complicated by an active iritis with adhesions, the tension was further elevated and a severe increase of pain initiated.

phrin, 1:4,000, solution and wait ten minutes.

4. Take tonometric readings.

5. Apply thermophore steadily and constantly held rather firmly against the globe astride the limbus for five minutes at 140 F.

During this application the speculum or lid retractors may be used or the lids may be held away from the conductor with the fingers. If the continuity of the application is interrupted or the contact surface of the conductor shifts its position, the effectiveness of the application will be diminished.

6. Take tonometric readings.

7. Take additional tonometric readings one hour later.

Until we did this we did not know that, following the sharp cocain-epinephrin fall in tension, there was a rebound carrying the tension up to or above its previous level. We are now engaged in some experiments with cocain-epinephrin-pilocarpin combina-

tions in the hope of getting an anesthetic that will eliminate this rebound. In all simple cases the rebound has caused no additional pain and has disappeared by the next day. In complicated cases with secondary changes the rebound may cause severe pain.

In all cases all treatment of every kind was stopped after the thermophore application so that no other factor had to be considered on succeeding days.

CONCLUSIONS.

Our technic is not sufficiently finished and our experience does not extend over a long enough time for us to offer this as a better method than the usual medicinal and operative procedures at our disposal.

It is, however, a fascinating study because it appears to be a safe method of experimentation. We do not think that we have done harm in any case, and we feel that it offers marked possibilities in the effective treatment of glaucoma without risk of infection, and with practically no risk of intraocular

hemorrhage. We have not found it necessary in any case to put the patient in the hospital, and in some cases did not find it necessary to bandage the eye.

We are not by any means sure that we have developed the best technic. We are not certain that we are using the best size or shape of contact surface, nor are we certain that a shorter exposure at a higher temperature, or a longer exposure at our present, or a lower temperature, will not produce more permanent results. It may be possible to get a permanent result by using two or three exposures at intervals of two or three weeks.

In short, we have entered a new field, and it will take several years to develop its possibilities and limitations.

We are under great obligations to our senior associate, Dr. A. E. Ewing, for numerous valuable suggestions and constant encouragement, as well as for a large part of the clinical material at our disposal.

VISUAL FATIGUE.

EDWARD JACKSON, M.D.

DENVER, COLORADO.

This is a discussion of the known and probable changes produced by fatigue, and their possible location. The junction of nerve and muscle through the end plate, and the junction of synapses of the nerve cells are probable locations of fatigue changes. Visual fatigue is essentially different from usual muscle fatigue, and is related rather to activities of the central nervous system. Adaptation is a special form of fatigue fitted to economize effort. Read before the Colorado Congress of Ophthalmology and Otolaryngology, July, 1920. For discussion see p. 133.

The supposed basis of fatigue is exhaustion of prepared cell nutriment, and accumulation of waste products of cell activity; with a probability that the latter process brings a decrease of activity, before the stored nourishment in the cell is nearly exhausted. As regards muscle cells it seems fairly well established that the accumulation of acids, especially carbonic and lactic, is closely associated with diminished responses to stimuli.

The nature of the products accumulated in the nerve cell is not so clear. Crile and Lower¹ found in shock or exhaustion, visible changes under the microscope in nerve and gland cells, in the brain, suprarenals and liver.

The symptoms of general fatigue, slow and feeble motor reactions, blunted perceptions, disagreeable sensations of general weariness, desire to sleep, indisposition to exertion or activity, either muscular or mental, which are familiar to all persons, may be attributable to such changes. But we cannot regard them as necessarily following fatigue of a limited neuro-muscular tract, such as is directly concerned in the act of vision, altho fatigue of such a limited tract may contribute to a general fatigue.

Visual fatigue may contribute to general weariness, but can hardly cause it alone. It may be essentially similar to general exhaustion in the histologic changes on which it rests; but there is a wide gap between our knowledge of chemic and histologic changes; and the clinical manifestations of fatigue that confront us as a practical problem. Even of weariness produced by exertion of the large muscles, as in walking, Barker² says, "Whether this is due to centripetal impulses arising in the muscles themselves, or to a change in the nerve cen-

ters in the central cortex is not certain."

The number of points at which fatigue might occur so as to lower activity or cause sensations of which we are conscious, are thus enumerated by Herrick,³ who bases them on the summary of Stiles." (1) fatigue of muscle fibres, (2) fatigue of the junction of the motor nerve with the muscle fibre at the motor end-plate; (3) fatigue of the nerve-fibres, (4) fatigue of the motor nerve cells; (5) of the synapses between the nerve cells, (6) fatigue of the sense organs and afferent apparatus, (7) fatigue of the centers of voluntary control."

Physiologic experiment shows that the nerve fibres are capable of conducting impulses after the neuro-muscular apparatus has become exhausted and fails to respond to stimulus; and that muscle fibres cease to respond to impulses coming thru the nerve trunk, and yet contract well under direct stimulation. This shows that neither the muscles or the nerve fibre is exhausted.

Stiles⁴ thinks the junction of nerve and muscle is especially likely to give out under continued stimulation. He says: "One is tempted to draw a comparison between the end-plate and the safety fuse such as is used in connection with an electric fixture. The fuse is intended to be destroyed under conditions which might otherwise threaten damage to more valuable portions of the system. It is readily renewed. So we may think of the end-plate as something easily impaired by use, but also easy to repair. It is better that wear and tear should fall upon this structure than upon the more highly organized protoplasm of nerve cells or muscle fibres."

Next in importance as a point especially liable to manifest fatigue, are the

synapses thru which stimulation of motor nerve cells is effected. It is easily conceivable that here a break in the circuit may occur; and that one set of these being out of use, another set can be brought into service under forced effort, made to continue the action. What changes mark physiologic fatigue in the body of the nerve cell, or to what extent it is the seat of fatigue we can only guess. The important point to be here impressed is the large number of structures, any one of which might present essential alterations of fatigue; and our lack of definite knowledge of its location.

Overuse of the large muscles produces symptoms directly referable to the seat of increased activity, including pain, that arises into consciousness and causes inhibitory impulses that tend to check the use of the muscle. There is pain produced by pressure on the muscle or its tendons; and this soreness or tenderness seems identical with that produced by simple bruise of the part. One symptom of muscle fatigue is local pain due to congestion, but such pain is rarely complained of about the eye. Lippincott⁵ reported localized congestion over the insertion of the internal rectus in three cases. I have seen something of the kind, but very rarely. Patients complain of general soreness "back of the eye," and show decided wincing when the eyeball is pressed back into the orbit. This might indicate soreness in the extraocular muscles deep in the orbit and particularly in their tendons of origin and points of attachment.

But it is characteristic of muscle soreness from overuse that it is a temporary symptom. One starts to play tennis or to swim at the beginning of the season, or takes a long walk; and after the one day of rather prolonged exercise his muscles feel sore. But if he continues such use of his muscles daily, the soreness will reach its maximum in a very few days; and in two or more weeks will have disappeared entirely. If the beginning of the unaccustomed exercise is quite gradual, and the period gradually lengthened, or when the exercise is habitual no such symptoms will arise. We may suppose that in the case of the eye, habit or more gradual change in the way the eyes are

used, eliminates this symptom of fatigue.

Perhaps the most constant and general symptom of visual fatigue, is a sensation of dryness, roughness, burning, smarting, or feeling of a foreign body in the eye. Children are told the "sandy man" is after them and they must go to sleep. These sensations bring to us a fair proportion of patients. Ferree and Rand⁶ have depended largely on the discomfort produced in their experiments on the production of fatigue by various colors and forms of illumination. Some individuals and the members of some families are especially liable to it; but the mass of eye workers can accept such sensations as a fair notice that it is time to stop work. It seems closely connected with hyperemia of the conjunctiva, and might be an expression of weariness in certain parts of the visual apparatus thru lowered vasomotor tone. Failure to heed the warning it gives furnishes cases of chronic conjunctival hyperemia and inflammation, or makes such disease resistant to treatment. Attacks of conjunctivitis due to visual fatigue are common among presbyopes who are deferring the use of the needed help for accommodation.

In this respect we may trace one more analogy between eye and brain. As Weir Mitchell⁷ puts it: "It is only after very long misuse that the brain begins to have means of saying, 'I have done enough': and at this stage the warning comes too often in the shape of some one of the many symptoms which indicate that the organ is already talking with the tongue of disease."

Still more does the eye speak with the "tongue of disease" when it expresses fatigue by eyeache or headache. In the mass of cases these symptoms express the establishment of a pathologic reaction to stimulus; rather than an expression of temporary weariness, that a period of rest will presently remove. Whether in either brain-work or eye-work the aching originates in centripetal impulses, or in exhausted central cells, we do not know. Local influences like pressure on the eye or head may modify pain or relieve it; but this does not throw light on the locality of the morbid action, as it does in

the case of the soreness of muscles and tendons.

The close association of eye and brain symptoms may arise from the fact that the brain, or certain parts of it are using the eye to effect certain purposes. As H. C. Wood says,⁸ "The thinking machine—the brain—works with certain tools. It is clear that, if these tools or instruments be dull or out of order, an enormous loss of power must occur in using them. The most important of these tools of the brain are the special senses. It is of the first importance to have the organs of the special senses in good order." "This process of eye-strain and brain-strain may go on unrecognized for years, until at last the individual is arrested by the giving out of the brain, or by the retinal irritations becoming so severe that vision is no longer endurable." Again the lesson is not recognized until proclaimed by the "tongue of disease."

Whether the aching of some myopic eyes belongs with the eyeaches and headaches of hyperopia; or whether it should be classed with the soreness of the overworked muscle and congested tendon is somewhat uncertain. Perhaps both kinds of aching contribute to these exceptional cases.

Fatigue of the retina and visual centers is of more importance than all other forms of fatigue connected with vision. We cannot discriminate between that which belongs to the retina and that which belongs to the intracranial neurons of the visual apparatus. Nevertheless we have some definite knowledge about this kind of visual fatigue. In the first place it is attended with lowered visual acuity. This dropping of visual acuity begins very soon after the eyes are brought into use; and it is a phenomenon common to all the eyes we test. We find habitually that a patient with the eye properly focused gets his best vision on first looking at the test card, after a slight period of rest. If he does not utilize it and attempts to decide on doubtful letters by steadily looking at them, he makes more and more mistakes. Often the patient almost says the right letter or quite utters it, and then immediately changes his mind and says something else.

This original maximum of retinal-central resolving power, very quickly drops to a noticeable extent, and then decreases much more slowly, soon reaching a level where little change may be noted for a very long time. Its course is modified by age, by previous exposure to light and by disease. It is closely associated with adaptation—indeed is a phase of the same process. In many patients decidedly better vision can be obtained even by the best daylight, after they have been kept several minutes in the dark room, or in a dimly lighted reception room. This is particularly the case with patients who have retinal deterioration with high myopia or other intraocular disease. This latter fact points strongly to the retinal nature of this form of fatigue. But it is not established definitely enough, or sufficiently supported by experiment or special observation to settle the point completely. It may be agreed that this manifestation of fatigue is partly or sometimes retinal, but it is not established that it is always or wholly retinal.

Closely related to the matter of lowered visual acuity is the fatigue significance of after images. These have received some attention in the literature, altho not as much as their practical importance warrants. In all our visual and especially our accurate color testing, and testing of night vision, more attention must be paid to the matter of adaptation, the elimination of after images of all objects previously looked at.

Another point about retinal-central fatigue is that it is increased by great difference in the intensity of stimulus to which adjoining parts of the retina are subjected. This disagreeable effect of looking at a bright light against a dark background is familiar to all of us, and is a common cause of complaint by patients. Clearly such contrasts are fatiguing, and must be reduced to a minimum compatible with the required use of the eyes. This phase of fatigue is of all the greater importance, because the resolving power of the eye depends on sharpness of contrast.

Our reading of black letters on a white ground is an instance of this application

of resolving power. The sharper the contrast the farther away the letters can be recognized; but the greater the fatigue if the reading is continued. Here as elsewhere a compromise, or medium adjustment of contrast must be sought which will give the optimum of efficiency for the eyes. Brightness of illumination of the page, color of the background and general illumination of the room in which reading is to be done, all have to be considered. There is need for systematic observation with regard to all these factors, in general; and also with reference to the particular patient to be considered.

Finally we have to consider fatigue of coordination; for the visual act is extremely complex—is only complete by the coordination of many separate physiologic processes. This kind of fatigue arises somewhere in the central nervous system. We do not know exactly where, but the synapses of the neurons may be assumed as a probable location. The stimuli for each of the six muscles of each eye must be coordinated with each other, and with the sensory impressions on the retina, in order that the eye shall be turned in the desired direction. The stimuli to the muscles of the two eyes have to be coordinated for binocular vision. The sensory impressions have to be coordinated with each other and with visual memories. This makes an extremely extensive and elaborate system of coordination, beside which the most complicated telephone switch board must seem simplicity itself.

Probably the usually recognized signs of eye weariness are fatigue of coordination. When paresis of one or more ocular muscles arises, the strain to coordinate under such a handicap quickly causes headache, vertigo, nausea, abandonment of binocular vision. The lack of correspondence of the images obtained

thru new glasses, with the visual memories of the patient, causes the distortion of perspective and judgment; and the ensuing annoyance of fatigue, that patients complain of so bitterly when oblique cylinders or lenses of unequal strength are prescribed to correct their ametropia. Even the fatigue of good eyes for ordinary near work must be largely a matter of fatigue of coordination. In my own case, the effort of keeping up binocular fixation and avoiding diplopia, with the necessary accommodation for reading, when getting drowsy, comes nearer to the effort of completing a long walk or mountain climb, than anything else my eyes have to do.

Some realization of the importance of this fatigue of coordination should give a better balanced judgment as to the adoption of therapeutic measures for the relief of eyestrain. The problems of visual fatigue are important, timely, practical problems, to which the recent advances of our knowledge of physiology, with carefully devised methods of experiment can be applied with great prospect of achieving results of value.

Some analysis of the different forms of such fatigue, an attempt to localize the essential change that gives rise to fatigue, and a recognition of the extremely important part that efforts of coordination play in producing fatigue, ought to be useful in giving us a better conception of a condition that passes easily from physiologic to pathologic significance.

It should be borne in mind that normal visual fatigue rarely rises into consciousness. Only when the organism in response to long continued or repeated excessive fatigue has developed a method of translating this into discomfort or pain, does it develop into symptoms that bring patients to us for relief.

LITERATURE.

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2. Barker. Osler and McCrae. *Modern Medicine*. v. VII, p. 19.
3. Herrick. *Introduction to Neurology*, p. 101.
4. Stiles. *The Nervous System and Its Conservation*, p. 105.
5. Lippincott. *Trans. Amer. Ophth. Soc.* v. 4, p. 480.
6. Ferree and Rand. *Amer. Jour. Ophth.* v. 1, p. 255.
7. Weir Mitchell. *Wear and Tear*, p. 14.
8. Wood. *Brain Work and Overwork*. p. 64.

NOTES, CASES AND INSTRUMENTS

PARALYSIS OF THE EYE MUSCLE AFTER ALCOHOLIC INJECTIONS FOR TRIGEMINAL NEURALGIA.

DR. J. FEJER,
BUDAPEST, HUNGARY.

It is a well known fact that surgeons and neurologists often perform in the case of trigeminal neuralgia alcoholic injections. Often this proves very successful, for the alcohol getting into the vicinity of the above mentioned nerve, produces a perineuritis, or a chemical necrosis; in short, it calls forth an anesthesia in the nervous cord and the pain ceases. But sometimes the way of the alcohol jet is not calculated precisely enough, it gets near another nerve and annihilates its function.

In my practice I had two such cases, in the first it was the nervus abducens, in the second the nervus oculomotorius which has been paralyzed by the alcoholic injection. My cases are in brief report as follows:

1. A lady of about fifty years calls upon me with the complaint that for the last few days she sees everything double. The patient is very short-sighted, the mobility of the right eyeball is checked in lateral direction. She relates that more than once she has been injected with alcohol in consequence of neuralgia trigemini, and her state grew better in some degree. After the last injection, however, which she got in the region of the right malar bone, under the right inferior eyelid, her eyelids swelled up intensely and a week later paralysis became manifest. The internal use of Sajodin ameliorated her state very much, the double image disappeared.

2. My second case was that of a woman of about 32, who, having suffered from stinging pains in the region of the left supraorbital notch some months ago, received an injection in that part. Her eyelids became swollen for months afterwards. After the retrogression it appeared that the patient could but scarcely move her su-

perior eyelid, the mobility of the left eyeball was checked both upwards and downwards, the capacity of accommodation weakened; in a word, only the muscoli internus, externus and obliques are active, of all the eye muscles. The left pupil is larger, rigid and does not respond to the light reflex. Both eyes are subject to hypermetropic astigmatism. The eyeground is intact. This state has continued for the last year and there are no signs to indicate any amelioration.

Both my cases prove that the alcoholic injection in the region of the eyeball is by no means so free from danger as Prof. Pichler maintains it in his last paper. Cases of atrophy of the nerves are described already in the literature (Koennicke). Keratitis neuroparalytica has been noted after such injection in many cases. Therefore, let us be extremely careful with this indication. The selection of the technical method, too, ought to be effected with the utmost deliberation.

FLUOROSCOPY FOR OCULAR FOREIGN BODIES.

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W. D. HORNER, B.S.M.D.

SAN FRANCISCO, CAL.

The removal of foreign bodies from the orbit and globe has fortunately been greatly simplified by X-ray localization. Certain cases occur, however, where either through the localizing method employed, or faulty technic, the foreign body is found elsewhere than the point designated by the radiographer.

A distance of only a few millimeters is of the utmost importance at times in differentiating between an intraocular and an extraocular foreign body. In one of our cases a foreign body was localized just external to the globe, whereas ophthalmoscopy showed it lodged in the retina. An accurate localizing method and careful technic cannot be too strongly emphasized.

The improved Sweet localizer is said to be accurate to a fraction of a millimeter in an eye of normal dimensions, i. e., assuming 24 mm. to be the average diameter. In eyes with high degrees of hyperopia or myopia, the diameters will, of course, vary widely from this. In a myopic eye measuring 27 mm. an intraocular foreign body computed for the average diameter (24 mm.) might be diagnosed as extraocular. Conversely, in a hyperopic eye measuring 21 mm. an extraocular foreign body might be erroneously located as intraocular. Thus between a high myopia and hyperopia the diameters might easily vary 6 mm. or more.

Where the foreign body is not acted upon by a magnet, as glass, copper or aluminum, removal is made more difficult, and surgical exploration must be resorted to. In this type of case, or where there is doubt as to the exact location of the body, a most useful adjunct to the usual localization is the fluoroscope; assuming, however, that the foreign body is large enough to be readily seen under the screen.

The following case which came under our care, is briefly reviewed as an example:

Mr. W., age 38, was referred to us by his internist for eye examination. He complained of severe neuralgic pains in the temples and right side of the face. There was also a history of additional pain, at times, in his legs and right side. One and one half months previous, a rhinologist had opened and drained the right antrum.

The general physical examination was reported negative. During a recent X-ray examination for possible peridental abscesses, a foreign body had been discovered in the right orbit. Localization made by the Sweet method gave its position as 3 mm. to the nasal side, 13 mm. above and 9 mm. behind the center of the cornea.

The patient had insisted upon the removal of the foreign body, and was referred to us for that purpose.

Vision proved to be 0.8 in each eye, and the fundi, fields and tension were normal. Removal of the foreign body

was decided upon and the patient entered the University Hospital.

A supraorbital incision was thought advisable, as the body lay apparently above the globe. Careful exploration, however, failed to locate it. Having witnessed Dr. Saxton Pope, of our Surgical Staff, remove a nail from a child's lung by means of the fluoroscope, we decided to apply this method to the case at hand.

The supraorbital incision was covered by a sterile dressing and the patient, still anesthetized, was removed to the X-ray room and placed upon the fluoroscopy table. Under surgical precautions, and directed by the screen a probe was introduced into the wound, and the relation of its tip to the foreign body noted. The bulbar conjunctiva was then grasped near the limbus and the globe moved in various directions. The foreign body was seen to move with the eye. It also moved when traction was made on the loose tissues of the lid. These observations made us conclude that the foreign body was either lodged in the sclera or episcleral tissue and that it lay nearer the nasal side than was shown in the X-ray.

The patient was returned to the operating room. With its relations in mind, the foreign body was located and removed without further difficulty thru a conjunctival incision. The body measured 9 by 2 by 2 mm. and was a spicule of iron.

Subsequent history developed the interesting fact that fifteen years before, when "shearing" metal, a piece had struck the patient over the right eye but it had been treated as a minor superficial wound and he had entirely forgotten about it.

Fluoroscopy offers an additional aid in the location and removal of ocular foreign bodies in a certain percentage of special cases.

A CASE OF BILATERAL PULSATING EXOPHTHALMOS.

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SEATTLE, WASHINGTON.

Mr. G. G., age 23, was injured at Thayne, Alaska, on October 17, 1919, in the following manner. While coupling two ore cars his head was crushed

between the two cars. He was taken to the hospital in an unconscious condition where he remained for three weeks, and was then transferred to the Seattle General Hospital.

At that time the examination was as follows: Mentality clear. *Eyes*—A marked exophthalmos both right and left; eyes straight forward; ptosis of both upper lids; both eye balls were fixed and slightly divergent. Protruding between the lids of both eyes was a large edematous fold of conjunctiva 1 cm. wide with slight necrosis of the superficial layers. Both corneae were slightly hazy at the lower margin in the central region. A sticky secretion covered both corneae and conjunctivae, but no organisms were present in the smears. Both corneae were insensitive. Both pupils were dilated and fixed.

Ophthalmoscopic examination revealed a marked whiteness of both optic discs; the arteries and veins were tortuous and markedly distended; areas of white exudate covered the vessels, especially in the region of the disc and macula; small hemorrhages appeared everywhere in the retina.

On palpation a distinct pulsation could be felt from both the eyes. With the stethoscope a distinct bruit could be heard over both temples of about equal intensity; the bruit could be heard as far back as the posterior border of the zygoma while in the midline of the forehead a very faint bruit was heard. The face on both sides was insensitive to touch; and both sides of the face were paralyzed. There was a mucous discharge from both ears and a serous discharge from both nares. A roentgenogram revealed no evidence of fracture of the skull.

The diagnosis of a double pulsating exophthalmos at that time was made with the following cranial nerve involvements: right and left 2nd, 3rd, 4th, 5th, 6th and 7th nerves. The vision at this time was fingers at 6 feet, in both eyes; an effort was made to protect the cornea by keeping the cornea and conjunctiva covered with sterile vaselin, but on December first it was necessary to remove the folds of conjunctiva in order to save the cornea.

On December 4th a marked change had taken place. Previous to this time ligation had not been considered advisable because we were unable to determine which side seemed to be the most favorable for operation. The examination on December 4th showed a sudden increase in the extent of the bruit on the right side. Whereas before the outward limitation was at the posterior border of the zygoma, it could now be heard back of the mastoid region. The patient complained of a dull throbbing of the head on the right side; the right face showed a slight edema and it was decided to ligate the right internal carotid. This was done by Drs. Plummer and Eagleson the following day. After recovery from the anesthetic the patient remarked that the throbbing had stopped. There were no cerebral symptoms following the operation, and recovery has been uneventful since.

RESULT. The recovery in this case is of interest. The right eye which before ligation showed more changes than the left, now rapidly became the better eye of the two, notwithstanding the fact that there were more corneal involvement in the right than the left. The optic disc gradually receded until now a delicate haze alone remains; while the vision is 3/10 with an astigmatic correction lens. The third nerve is now practically normal while the sixth nerve is still paralyzed. The anesthesia of the cornea still remains but the sensation has returned to the entire right face. The facial muscle is beginning to show signs of repair. He can now close his jaws and elevate his right lip. The bruit has not been heard since the ligation and the eye has receded to its normal position.

On the left side the vision is now fingers at 6 feet (apparently no change), the disc is still blurred and the eye is still slightly prominent but apparently is receding somewhat. Sensation is absent over the distribution of the inferior branch of the fifth nerve only. The fourth and sixth nerves are still paralyzed, but there has been a marked improvement in the condition of the third, altho the eye cannot be moved to any extent. The seventh is normal. The ear

drums have healed, and the hearing is practically normal, altho a little less in the left than in the right.

SUMMARY: Pulsating exophthalmos of both sides with involvement of the second, third, fourth, ophthalmic division of the fifth, the sixth and seventh nerves on both sides, was the immediate result of injury. Evidently edema and possibly some hemorrhage accounted for the lesion of the other branches of the fifth. (2) An enlargement of the aneurysm on

the right side as shown by the subjective symptoms and the objective signs. (3) Ligation was not accompanied by any shock to the patient, and resulted in marked improvement. (4) The repair of the cranial nerves has been in line with their involvements; the last involved being the first to repair. (5) On the left side where no ligation was performed, a moderate degree of improvement has taken place, altho not to be compared to the improvement of the right side.

SOCIETY PROCEEDINGS

Reports for this department should be sent at the earliest date practicable to Dr. Harry S. Gradle, 22 E. Washington St., Chicago, Illinois. These reports should present briefly the important scientific papers and discussions.

PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY, COL- LEGE OF PHYSICIANS OF PHILADELPHIA.

October 21, 1920.

DR. G. ORAM RING, CHAIRMAN.

Orbital Sacoma Treated with Radium

DR. HOWARD F. HANSELL exhibited a case of tumor of the orbit, probably sarcoma, of two years' duration. The patient had been treated by X-rays for one year and for the last six months by radium. The only benefit of the treatment has been to prevent rapid growth. The treatment will be continued and operation postponed until the last moment.

Perforation of Globe by Particle of Dynamite Cap.

DR. BURTON CHANCE described, briefly, a case, and exhibited the eyeball which he had excised from the orbit of a Polish boy of five or six years, who recently, while striking a dynamite cap between two stones, was wounded in his left eye. The history of the interval between the wounding and his admission to the Wills Hospital, early in October, is not obtained, as the child's family could not speak English. When admitted, the orbital base was depressed, the fissure contracted, the globe somewhat shrunken. There were no scars, perceptible, on the globe. The cornea was clear; the anterior chamber of unequal depths; the iris bright green. No reflex was obtained from the fundus. At the enucleation the superficial tissues were densely adherent to the globe, especially over the nasal aspect. The nerve was cut without difficulty, but on attempting to deliver the globe it was found to be held fast deep in the apex. After many efforts, during which it seemed as tho one had to do with a neoplasm, the globe was finally delivered. The tissues were prolonged about 8 mm. very much as in the manner of a protruding growth. At the apex of the more or

less triangular mass pus oozed on pressure. On section of the globe and mass a bent copper cap was found in the pocket containing the pus. The globe was more or less quadrate; no positive cicatrix could be seen, but the muscles and orbital tissues had been lacerated and were massed together in the posterior nasal aspect without including the nerve. The almost globular crystalline lens had been dislocated and the choroid and retina detached and shrunken. The child made a good recovery.

Effects of Carbon Monoxid.

DR. W. H. WILMER, of Washington, D. C., by invitation, read the paper published in full on p. 73. The paper dealt with:

1. The frequency of exposure to carbon monoxid gas in all walks of life, domestic and industrial.
2. The voluminous general literature upon the subject, but the dearth of any detailed descriptions of the ocular lesions.
3. Its combination in the blood. Two opposing theories concerning its deleterious action upon the body tissues; by depriving the blood of its oxygen-carrying properties; or by a direct chemic action upon the delicate central nervous tissue.
4. The pathologic changes found in the central nervous system of fatal cases consist of great congestion of the vital organs; in the nervous system, inflammation, thrombi, hemorrhages, fatty degenerations and atrophic changes.
5. A detailed account of the chronic poisoning by the gas from a faulty hot air furnace of an entire household over a period of two months. Special note of the hallucinations of vision, hearing and touch.
6. A report of the case of one of the children (four years old at the time of exposure) who suffered from a double optic perineuritis.

7. The report of a case of a man of thirty-five years of age whose optic atrophy was due to carbonic oxid from the fumes of a gasoline torch.

The paper closed with the following conclusions:

The exposure in modern life to the influence of carbon monoxid introduces an additional cause of eye lesions. As carbon monoxid is present in all of the gases connected with domestic and industrial activities, possibly it has been responsible for certain obscure amblyopias that have been attributed to other chemical substances. Its causal relation may be obscured at times by some other very evident source of toxemia, such as septic tonsils, apical abscesses, syphilis, etc.

It is not of vital importance to the ophthalmologist whether carbon monoxid manifests its serious effects as a distinct chemic poison, or whether it deals destruction purely by its power of quickly depriving the blood of its essential oxygen-carrying power. But it seems to the writer, after much experience with pure oxygen want, artificially produced, that there is much truth in the two opposing theories. On the one hand, the physiologist sees the dramatic effect of carbon monoxid upon the person who takes one whiff of the concentrated gas and falls as if electrocuted; or he is interested in those cases which finally become unconscious after a longer exposure to fumes of lesser strength. Moreover, he sees the results of experimentation in the laboratory, and he is quite rightly impressed by the effect of this gas upon the oxygenation of the blood. But he does not come in contact with the final consequences of the prolonged, but intermittent, exposures to infinitesimal doses of this gas—results which are of such interest to the clinician. In these cases, the symptoms run the gamut of clinical medicine.

The history of carbon monoxid convinces one that, apart from the effect upon the hemoglobin, it is chemically inert compared with the toxicity of other well-known chemic substances. However, one cannot but feel that after a prolonged attack upon the body tis-

sues, it exerts a deleterious influence which is apart from its purely oxygen-depletion effect—tho the latter does sensitize the delicate structure of the central nervous system.

Carbon monoxid does not show any great predilection for the optic nerve fibers as a whole, nor even for the very sensitive papillomacular bundle which is so markedly affected by alcohol, nicotine, etc. The ocular nerve lesions seem to be due to changes in the delicate structures of the nuclei of origin of these nerves.

However, thru its effect upon the sensitive fabric of the central nervous system, carbon monoxid does cause ocular paralyses, hemianopsias, disturbances of pupillary reactions, optic neuritis, and, actually, optic atrophy. Like pure asphyxiation, it is the source of great ocular congestion, and in this way it does cause subconjunctival and retinal hemorrhages; while in the milder cases of carbon monoxid poisoning congestion of the respective cerebral centers causes hallucinations of vision, hearing and touch.

The writer feels that the first case reported is one of optic neuritis due entirely to carbon monoxid poisoning. This seems to be a logical conclusion to draw from the history of the case, the great general disturbance, the very slow recovery, the elimination of every other toxic source, and the recognized susceptibility of children to this gas.

In the second case, carbon monoxid is the probable cause of the optic atrophy, by reason of the very clear history of ocular and other disturbances that followed each exposure to its fumes, and the exclusion of all other toxic sources.

The treatment seems to resolve itself into remedies suggested by the symptoms, prophylaxis, hygiene, and the legislation that should follow the proper education of the public in regard to the insidious toxicity of this "Frankenstein" of advanced civilization.

DISCUSSION—DR. H. A. HARE spoke of the relationship of carbon monoxid and illuminating gas, fuel gas and coal gas.

In all cases of gas-poisoning carbon monoxid seems to be the chief factor but in very few instances is it the only gas which is responsible for the symptoms, the chemical composition varying with the coal used, and the temperature employed in generating the gas. The point is whether it is coal gas or illuminating gas, commonly called water gas. Water gas contains a much higher percentage of carbon monoxid than does the gas made from coal. Thus Professor Remsen put the percentage of carbon monoxid in coal gas at 7.9 and in water gas 28.25.

He spoke of the greater affinity of carbon monoxid for hemoglobin than has oxygen, and referred to the article in Witthaus' Medical Jurisprudence and Toxicology, Vol. iv, that states that in some cases of survival certain disturbances, notably those of the nervous system, persist for months or years, due to hemorrhages and softening caused by the impoverished condition of the blood, but more usually the patient recovers completely in the course of a few days.

After describing the symptoms in general, consisting of loss of muscular power and unconsciousness, he adds that vision is impaired during recovery and in some cases there is deafness. So, too, Herold states that vision is disturbed.

Further on Witthaus states that a very characteristic lesion in prolonged carbon monoxid poisoning is the occurrence of hemorrhages and softening in the cortex and central nuclei of the brain, notably in the two internal segments of the lenticular nucleus. These lesions are frequently symmetric and due to degenerative changes in the coats of the arteries.

He then gives about a dozen references, all of which are to German literature, as justification for this statement on his part.

It is interesting in connection with the statement made above concerning lesions of the lenticular nucleus, to note that the distal group of vessels coming off of the circle of Willis or the lenticulostriate arteries send branches to the outer segment of the lenticular nucleus

and that the lenticulooptic arteries pass to the outer and posterior parts of the lenticular nucleus and the outer part of the optic thalamus.

In this country, Dr. Dana of New York, while dealing with another aspect of nervous lesions, has contributed information of interest in this connection. Thus, he has pointed out that it is very common, if not almost universal, to find as an effect of gas poisoning, a softening of both lenticular nuclei if the patient has been unconscious from the effects of the gas for more than twenty-four hours. He quotes Ziemssen as having reported a case of gas-poisoning with softening of the corpus striatum in 1864, while Simon reported that gas-poisoning caused thromboses and softening of the brain, particularly of the lenticular optic region, in 1868. Thus, in a case of gas-poisoning in a woman aged forty-six years, the autopsy showed in the left side of the brain a spot of softening the size of a cherry in the middle of the corpus striatum which at the limit of the thalamus behind was more solid. A similar but smaller lesion was in the right striatum, with no other spots of softening.

To quote Dana: "In 1898, Kolisko published a series of articles upon the bloodvessels of the brain. In this he particularly called attention to the existence of a special artery which is given off from the anterior cerebral, near the communicating branch. This artery is usually single, but sometimes double. It runs upward and backward, and it supplies the caudate nucleus, part of the anterior portion of the internal capsule, and part of the outer portion of the lenticular nucleus. Owing to the length and peculiar direction of this artery, the blood that passes into it has to flow rather against the normal current. The result is that the pressure in this artery easily becomes relatively less than that of the other vessels, and when the general blood pressure is very low, as in gas-poisoning, a tendency to stasis and thrombosis occurs. This artery is the one, then, that is particularly selected as that in which thromboses occur, and Kolisko states that it

has as much right to the name of "the artery of cerebral thrombosis" as the branch from the middle cerebral has to the name of the "artery of cerebral hemorrhage." It is an involvement of this artery on each side which occurs in cases of gas-poisoning, and which leads to the very common lesion of bilateral softening of the corpora striata in that condition."

Dana also quotes Klebs as reporting a case of softening of the corpus striatum with a sharply limited focus and two others with lesions in the inner parts of the lenticular nucleus and anterior part of the internal capsule.

Dana expresses the belief that it is well known that the most common and practically uniform lesion in gas-poisoning is that of the lenticular nucleus.

Finally, it is interesting to note the statement of Dr. Marshall, who is the physician employed by the United Gas Improvement Company, as to whether visual disturbances are met with in those employees who are exposed to gas fumes. Naturally, the experience of Dr. Marshall is a very wide one, and he said that he does not recollect a single instance where disturbance of vision was noteworthy.

DR. F. X. DERCUM said it was not surprising that in lethal cases lesions have been found in the basal ganglia and capsules, as this region is the favorite seat of vascular crises of all kinds and from whatever cause. This fact is due to the preponderating role which the middle cerebral artery and the branches which enter the anterior perforated space play in the vascular supply of the brain. Gross hemiplegias are met with in such cases, and that characteristic lesions are found at autopsy is not surprising. The lesions are, however, not limited to these regions. This is indeed indicated by the symptoms, which vary greatly. Palsies, gross in character, hemiplegias, local palsies of one or more limbs, and even paraplegias, have been described. The palsy may be flaccid or spastic; there may be fibrillary contractions, tremor, muscular twitchings and muscular spasms irregularly recurring or persistent. Finally, there may be convulsions. Cases with

gross lesions usually die and autopsies reveal hemorrhages into membranes and nerve tissues, foci of softening due to thrombosis, degeneration of nerve cells and fibers, chromatolysis, atrophy. The facts suggest the action of a toxin—possibly of a secondary toxemia—on the vessel walls. In cases that survive symptom-groups leading to the diagnosis of multiple cerebrospinal sclerosis may make their appearance. Probably we have here to deal with multiple foci, multiple small lesions, primarily vascular. A more frequent clinical picture is that of a multiple neuritis and it is this which in the light of Dr. Wilmer's interesting paper especially concerns us. Many such cases have been described, especially by French writers, and for reasons to which Dr. Wilmer has alluded. It is worthy of special note that the neuritis is usually not diffuse, but localized; indeed, when a diffuse multiple neuritis is present, it is quite legitimate to think of a possible and preexisting alcoholism. Most frequently the picture of a neuritis caused by carbon monoxid poisoning is that of a neuritis of one or more nerves of a single extremity. It would appear, also, from the observations of various writers, for example, Claude, who has especially studied this question, that the neuritis is not primary but is secondary to lesions of nerve centers a conclusion parallel to that of Dr. Wilmer for the neuritis of the optic nerve. The peripheral neuritis, when present, appears to be the outcome of lesions of membranes, hemorrhages or softenings in the nerve centers, or possibly to edema of contiguous tissues leading to compression.

Far more common, however, than organic changes, are the conditions which suggest a functional disturbance of the nervous system, which are not infrequently overlooked. Doubtless these are toxic in their origin, but whether due merely to the interference with the oxidation of the tissues caused by the carbon monoxid inhalation or to a secondary intoxication, it is impossible to say; more probably to the latter. Dr. Wilmer has already graphically described the symptoms which such cases

present. In brief they are featured by headache, backache, vertigo, tinnitus, weakness, atonic indigestion, impaired circulation, sleep disturbances. In individual cases, given symptoms may be especially pronounced. At times, too, as Dr. Wilmer has recounted, mental symptoms may be prominent and striking. There may be mental depression, irritability, impairment of memory, hebetude, apathy, marked mental impairment, confusion, hallucinations. At times a loss of memory is present suggesting a lacunar loss, in which the lacunae are filled in spontaneously and automatically from the subconscious mental content so that the picture of fabrication as seen in Korsakow's psychosis—itsself a mental disorder frequently associated with polyn neuritis—is simulated.

To Dr. Dercum it seemed that the so-called functional symptom-groups are practically of the utmost importance. They suggest toxemia plus exhaustion. Finally, we must be careful to differentiate such cases from the hysterics that are occasionally found in cases that have been exposed to gas-poisoning. Here the picture is that of palsies, contractures, or other motor phenomena, associated with typical hemi- and segmental anesthetics; and other crass hysteric phenomena. Clearly such cases are to be referred to mental shock and fright, just as are cases of so-called traumatic hysteria, and not directly to carbon monoxid poisoning. In conclusion, Dr. Dercum wished to emphasize the fact of our indebtedness to Dr. Wilmer for bringing before us such an important subject and in such a valuable paper.

DR. DE SCHWEINITZ congratulated Dr. Wilmer on his interesting and timely paper, which he deemed especially important in that it forcefully called the attention of ophthalmologists to the ever-present dangers of carbon monoxid poisoning, so often insidiously conveyed, and therefore all the more deadly. These dangers have frequently been studied and reported upon by physiologists, chemists, neurologists, and those interested in industrial medicine, but the ocular symptoms have not

received the attention which is their due. In many respects the gathered information on this subject, that is, carbon monoxid poisoning, is most satisfactorily compiled up to 1914, in Glaston and Logan's work on "Gas Poisoning in Mining and Other Industries," and contains a good résumé of the ocular symptoms, and in this city we are indebted to Spiller and McConnell for an excellent study from the neurologic and pathologic standpoints.

Dr. Wilmer has so well summarized the eye symptoms thus far recorded, as well as those he has observed, that there is little to add. Not the least interesting pupil phenomenon in acute carbon monoxid poisoning is the occasional development of an exaggerated hippus; nystagmus, for example, in those exposed to mine gases, is important because it would seem from recent investigations that miners' nystagmus, usually attributed to the strain caused by deficient light, or to muscle fatigue, or to insufficiency of fusion power, may be the result of a form of carbon monoxid poisoning. The optic nerve changes which Dr. Wilmer observed in one of his patients and in one under the care of Dr. Burke are a further confirmation of the fact that the damage may be a permanent one, as it was in the report of Brose, who found atrophic pallor in men exposed to the gases developed by the explosion of dynamite, and in that of R. Pirrie, who noted permanent optic nerve atrophy in two patients exposed to the fumes following nitroglycerin gas blasting; in all of these instances it was believed that CO might be the responsible agent, altho some other gas or vapor was not entirely excluded. That the hemianopsia of carbon monoxid poisoning is due to hemorrhages or areas of softening in some portion of the visual pathways seems well established, as pathologic investigations have demonstrated fatty degeneration in the intima of the vessels in the central nervous system. The bilateral softening of the lenticular nuclei in fatal cases of carbon monoxid poisoning, to which Dr. Wilmer has referred, first described in this country by Dana, is

well shown in an illustration from Spiller and McConnell's article, and is a frequent and almost characteristic lesion, altho not with reference to hemianopia. To what extent the ocular phenomena produced by this gas are due to its powers of reducing the oxygen-carrying power of the blood is not apparently known, and yet if Yarrow's contention (quoted by Dr. Wilmer) is correct, that the blood impregnated with this gas loses its power as an oxygen-carrier to the tissues of the body, it may well be accused in this respect. From all standpoints, and therefore, from an ocular one, it is well to remember that persons exposed to the influence of CO may apparently recover entirely, the recovery to be followed by the symptoms of the poisoning, or, in other words, a delayed reaction.

A practical lesson from Dr. Wilmer's paper evidently is that in the investigation of certain obscure optic nerve troubles and muscle palsies and certain types of unexplained visual field amblyopias, the possible relation of a slow and insidious carbon monoxid poisoning must not be neglected, nor must it be forgotten in attempting to explain, not only visual hallucinations, but so-called colored vision, for example, xanthopsia, which Hilbert has noted exactly as it occurs in santonin poisoning, and sometimes in other varieties of toxic amblyopia.

DR. HOWARD F. HANSELL said that Dr. Wilmer had done this community a real service in calling attention so emphatically to the danger to which we are all exposed either in the home or in the factory—to the danger of poisoning by carbon monoxid. He personally felt under deep obligation and would endeavor to profit by these thoughtful suggestions. Dr. Hansell had never knowingly seen a case, but he believed with Dr. Dercum that we pass many cases by without recognition. There is thus far no syndrome of ocular symptoms. The ophthalmologists who have written on the subject have described not more than one or two symptoms. The eye complications; paresis of the extraocular and intraocular muscles; disturbance of vision; concentric con-

traction of fields; double homonymous hemianopsia; mydriasis, miosis and paradoxical pupillary reactions; protrusion of the globe and nystagmus have been mentioned. The eye grounds are usually negative, altho venous hyperemia of the retina and exudation into the retina adjacent to the nerve have been reported. In addition, functional derangements may be attributed to the gas in those who are subjects of poisoning.

DR. L. C. PETER wished to add his vote of appreciation to Dr. Wilmer for his very interesting communication just read. The cases which he presented were of very great interest. Three phases of the case in which the visual fields were presented should receive special consideration. First, the total absence of gross fundus changes visible with the ophthalmoscope. In retrobulbar types of optic neuritis it is the rule to find no gross fundus changes. This case, however, covered a period of about two years, during which he was under observation, and the fields even now show considerable pathology. One would, therefore, expect to find some fundus changes.

Second, the papillomacular bundle is the first to show evidence of disease in toxic types of amblyopia; in this case the macula apparently escaped.

The third interesting point is the enlargement of the blind spots of Mariotte. Dr. Peter had been in the habit of calling the attention of the student body in the classification of optic neuritis to this particular type, which as a rule is rare, namely, a perineuritis giving rise to an enlargement of the blind spot. This patient is a concrete example of this rather unusual type of neuritis.

The fields, as presented by Dr. Wilmer, as of very great value not only from a diagnosis standpoint but from the standpoint of prognosis as well. Without involvement of the papillomacular bundle one would expect that the patient should make a fairly good recovery with little demonstrable damage to vision.

DR. EDWARD A. SHUMWAY said that

he wished to place on record a case of carbon monoxid poisoning, which he had seen at the University Hospital Eye Dispensary in May, 1918. The patient was a child, aged six months, of Jewish parentage, who had been in good health until three months of age, when the family were overcome during the night by coal gas from a defective heater. Their physician, who had been called in, found the older children vomiting, and the baby in a stupor, from which it was aroused after a few hours. Following this, the child had been unable to hold its head up, sit up, or use the lower limbs. Examination at the dispensary showed the child to be apparently blind and deaf. There was no response of the pupils to light. Eyeground examination showed suspicious pallor of the discs, and special attention was paid to the macular region, for the possible presence of a cherry red spot, to exclude amaurotic family idiocy as the true condition, but none was found, nor did it appear later, nor did the nerves become atrophic.

Dr. Spiller had examined the child, and had made a diagnosis of cerebral diplegia, probably due to carbon monoxid poisoning. The child has been seen at intervals since 1918, and while there was some improvement in muscular movements, there was permanent blindness and deafness. At no time, however, had there been any spasticity of the affected limbs, which was frequently found in cases of degeneration of the lenticular nucleus, and had been a notable feature in S. A. K. Wilson's cases of progressive degeneration of the lenticular nucleus of the family form.

J. MILTON GRISCOM, M.D.,
Clerk.

COLORADO CONGRESS OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

DR. MEYER WIENER, of St. Louis,
Presiding.

Friday, July 23, 1920.

(Continued from p. 886, v. 3, 1920.)

Visual Fatigue.

DR. EDWARD JACKSON, Denver, read the paper published in full, page 119.

DISCUSSION. DR. R. S. LAMB, Washington. This is a subject which has interested me tremendously, because from my viewpoint the local fatigue is often an expression of the general fatigue of the individual; but is manifest in the eye because of the fact that the eye is used more than any part of the body. As described by Dr. Jackson the process is quite complicated.

The natural tendency of fatigue is to shut down certain processes of activity, and in consequence there comes venous congestion. A congestion of the conjunctiva which is manifest by a gritty sensation, and is easily discovered by looking at the eye. In all likelihood there is a congestion of the veins of the ciliary body and processes, which has an influence on their secretion, if our theory is correct in regard to the manner in which the aqueous humor is secreted. Coincidentally, almost invariably, you may have asthenopia; which is due to the congestion having been more or less chronic, or having occurred over a long period of time. These are the cases in which turning the eyes from side to side or vertically one gets the subjective symptoms of pain. We know this is particularly vexatious and inhibiting to the action of the focusing muscle. The patient must be cautioned to use the eyes very little—perhaps a school boy or girl can throw aside the books for a week and get out into the open, where we come back to the conditions which we know are helpful to the eyes as well as to the general system. I think there has been too much of tendency to tide the patient over, and allow him to continue his vocation or his work under a strain. Perhaps he is forcing himself to get thru with an examination, or has some business affairs to attend to, that we are trying to tide him over. But if we want to prevent a permanent damage being done to the eye we will have to make him get away from his work for the time being, because that is the only way for the body to get enough resistance to help to overcome the condition permanently.

DR. W. L. BENEDICT, Rochester, Minn., It seems to me that we have three important points or conditions in visual fatigue: In the first place I would like to

have Dr. Jackson explain the difference between ocular fatigue and visual fatigue. I think that in giving psychology talks we find that the psychologists are very frequently using "fatigue," where the ophthalmologist will use "adaptation." The thing we usually speak of in fatigue, or tiring, means adaptation to them.

Now, in the practical application of fatigue we have the X-ray men, who are working in a dark room. Some of the men on my staff work with a light in the room and others in a dark room, and questions of individual adaptation are injected into this matter—the question of preference as to how much light they shall have.

The other point I would like to have the doctor explain is the advisability of putting on colored glasses; the glasses which are supposed to filter out some of the light.

DR. JACKSON. The term "visual" fatigue connected with vision, including the central apparatus concerned with vision, seemed better than "ocular" fatigue occurring in the eyeball. Fatigue attending use of the eyes seems more largely dependent on the state of other parts than it is upon the eyeball itself. The exception to that proposition is the retinal fatigue attending prolonged use of the eye for sharply contrasted objects like the print on a page. But other fatigue that is of practical importance probably arises in the coordination of the different actions required in vision. "Visual" applies to the whole visual act, "ocular" to what might occur in the eyeball.

Colored glasses have been used very extensively and very loosely, and with very hazy notions of what was to be accomplished with them. I believe that glasses that lessen the amount of light, filter out particular radiations, have their chief value as a supplement to adaptation. They can be used to do a part of the work of adaptation of the eye, when this would be excessive because of the particular conditions under which the eye is used. We use our eyes largely in indoor life and it is the indoor worker who needs colored glasses when out of doors. His eyes have become adapted to conditions of radiation different from those out of doors; and the glasses will help him to get over the gap between the two—to supplement the physiologic change. The whole subject of the use of glasses that act as ray filters, cutting out one set of rays or another, whether this depends on the color or some other characteristic of the glass, needs to be gone over with more consideration of color vision and the general subject of adaptation.

The tests that have been applied with reference to night flying seem to open up a very wide field, in which we can come to understand this process of adaptation much better than we have done. But I think that adaptation must be regarded as very closely allied to fatigue and recovery from fatigue. It is a specialized fatigue—a fatigue that serves a purpose. When we expose our eyes to bright light, if the eyes are adapted to bright light they serve us better. On the other hand, when we go into feeble light the rest, or dark adaptation, gives us an advantage.

AMERICAN BOARD FOR OPHTHALMIC EXAMINATIONS.

REPORT ON GRADUATE TEACHING OF OPHTHALMOLOGY IN AMERICA.

Starting with the proposition that the fundamental instruction of all members of the medical profession should be the same, it was long assumed that systematic teaching in special branches was unnecessary. The specialist, if he were to be tolerated at all, must develop by individual study and experience.

The opportunities offered by the older graduate schools of medicine were simply opportunities to see cases of the particular class in which the student was interested, to see how they were managed by those in charge of the work; and, incidentally, to have attention called to salient points in these particular cases, in a kind of limited clinical teaching.

Only within the last very few years has it come to be generally understood that this voluntary individual study; and clinical teaching with regard to the limited proportion of eye diseases that happened to present in the teaching service, furnished a defective preparation for special practice. But this has now been realized by many of those engaged in graduate teaching, and an active effort is being made to improve the methods of preparing for ophthalmic practice.

The methods of graduate teaching of ophthalmology are in a state of rapid transition. To emphasize what the change should be, and to chronicle what advances have already been made is the chief concern of this report. In this connection it must be kept in mind that marked superiority in plan of instruction, in one institution as compared with another, may represent the advances of only a few months; and the institution still considerably behind in its methods may quickly close the gap that now separates it from its more advanced competitors.

It must also be borne in mind that the need for good clinical teaching still exists and will continue to exist. The systematic teaching which those preparing for ophthalmic practice must have, will make clinical opportunities more valuable than they could ever be without it. To make

them of greatest value the contact of the graduate student with the case must be so close and so continued, and the supervision of the teacher so direct and minute, that only very small numbers of students can study a case together. Real clinical instruction to large classes is an impossibility.

The improvement of the quality of such instruction requires that all available opportunities for it be kept open and extended. The fewer the students that can be taught from a single case, the greater the number of cases that must be made available for teaching. Therefore the institution that offers only clinical instruction, altho it cannot furnish a complete properly rounded graduate course in ophthalmology, can furnish an essential part of such a course; and on that account should be sustained, encouraged and developed in every way possible.

With this clear understanding of the necessity for both classes of institutions, we believe that it will be helpful to those preparing for ophthalmic practice to divide, in a general way, institutions giving graduate instruction in ophthalmology into those that undertake to give a complete and systematic course, and those whose work is mostly or exclusively clinical.

Another fact regarding graduate courses in ophthalmology should be mentioned. In schools that are chiefly clinical, courses other than clinical have been announced. Thus a course on operations, or one on physiologic optics has been planned to be given when applied for by a sufficient minimum number of students; and lacking such a class, it would not be given. These courses were all voluntary. They were supposed to be available for those who wanted to take such extras. Those in fundamental branches were taken by a small proportion of the students, all of whom took the clinical work of the institution. The clinical work thus corresponded rather with the required curriculum of the undergraduate school, and these special courses to the electives.

This is still the status of the graduate teaching of ophthalmology in many of the

institutions of this country. What we have had has been clinical teaching of variable quality, supplemented by voluntary courses outside of clinical work. What is needed, and is now beginning to be supplied, is systematic teaching of fundamentals, followed and supplemented by clinical work; the whole course being bound together and made effective by testing its results by examinations covering the whole field of ophthalmology.

Our review of existing institutions for the graduate teaching of ophthalmology in the United States can now be made in a general way, by referring to each institution as following the old or the new plan. As this is the first review of the kind that has been made; and in view of the rapid transition that is going on in all these institutions, it is given without any attempt at exact statement of minute detail. Such a survey should be made again within a very few years; and correspondence between announced plan and actual offerings of instruction should then be closely traced.

BOSTON.

The Graduate Medical School of Harvard University has announced a rather elaborate grouping of elective courses of one month each, including all the fundamentals in ophthalmology. Some of these courses have been given during the last year, and some have not. The institution is clearly on the old style basis of opportunities for fragmentary, individual, elective study. For the month of May these courses are grouped and coordinated to the extent of offering daily a full day's work in ophthalmology.

The Massachusetts Charitable Eye and Ear Infirmary offers opportunities, including a wealth of clinical material handled by most intelligent and careful ophthalmologists. This constitutes a school of clinical instruction, for the few who serve as internes and assistants, equal to any accessible anywhere. But it gives no systematized course in fundamental branches, and exercises no care that the whole clinical field shall be covered in any unit of time. Boston University gives clinical courses in diseases of eye, with lecture courses in Refraction and clinical ophthalmology.

NEW YORK CITY.

In its Ophthalmic Service, the New York Eye and Ear Infirmary opens its great clinical field to graduate students thru separate courses on special subjects, as effective demand is created for each of these courses, by the coming together of a sufficient group of students. This is clearly the old plan of instruction.

The Manhattan Eye and Ear Hospital offers a nine months' course filling in the greater part of each day with eye, ear, nose and throat work. This is still largely clinical, altho provision is made for teaching of fundamentals. The latter needs to be systematized and extended, to bring the course fully up to the requirements of those preparing for modern ophthalmic practice.

The Herman Knapp Memorial Eye Hospital has until within a few months been upon the plan of clinical opportunities offered all the time, and special courses as applied for. It is now going on the new plan, a systematic course on ophthalmology given at definite times and in regular sequences thruout the year. These courses last 3 months and include an additional 3 months of clinical work. Each class is limited to five students.

The New York Post Graduate School and Hospital has had in operation for more than two years a three months' intensive course in ophthalmology; including real teaching in fundamental branches, with work in pathology under a full time teacher of that subject. This is carried on along with a full and comparatively well organized clinical course, and made to occupy the whole day, six days in the week. It is a course in which the student can do a great deal of hard work, and by it can gain a great deal in the time allotted. These courses are repeated in immediate succession throughout the year. The school is fairly well equipped, has a full and active corps of paid instructors, and is established on a basis that enables it to meet fairly well the modern requirements of graduate teaching in ophthalmology.

The building of the New York Polyclinic has been used during and since the war as an United States Embarkation Hospital. Its out-patient department has

been continued with a limited service, but it offers little else for the student.

PHILADELPHIA.

The Wills Eye Hospital, established partly to give opportunities for members of the medical profession to become better acquainted with eye diseases, offers no systematic instruction. Its clinics are open freely to the physicians who choose to visit them; and offer, daily, an abundance of cases of all sorts. These are utilized by students of the attending surgeons who are connected with teaching institutions. But with abundant material for the study of pathologic anatomy and histology, the opportunities for the study of this branch, fundamental to ophthalmology, is entirely neglected by most of those who visit the clinics of this hospital.

The University of Pennsylvania now includes, as its graduate school in Medicine, the former Medico-Chirurgical College and the Philadelphia Polyclinic. In these institutions in the lecture rooms and laboratories in West Philadelphia, and in various hospitals, is given a ten months' course. The first eight months include laboratory and class room instruction and demonstrations, as well as clinical work.

This course is given by 18 professors of various branches; Ophthalmology 6, Neurology 3, Anatomy 2; and one each of Neurosurgery, Pathology and Bacteriology, Physiology, Surgery, Roentgenology, Medicine and Psychology; with 8 associate and assistant professors, 3 instructors and 3 assistants. The class is limited to 16 students. An average of about 6 hours formal instruction per day is provided, for five days in the week, with some laboratory work and clinics on Saturdays. Access is given to adequate medical libraries; and the student is required to make detailed reports of certain cases.

The basic schedule of study varies somewhat from month to month, including in the beginning the anatomy, physiology, refraction, case histories and records, medical ophthalmology, and ophthalmoscopy, especially of the normal fundus, with a few clinics. Later the clinical work increases, the classes being divided into sections and there are dem-

onstration courses on injuries, operations, etc. The last two months are purely clinical.

For the successful completion of the above course the passing of an examination after the end of the first eight months, the student is given a certificate; or a permit to enroll for the second year course. The second year course is devoted to certain advanced studies, practical work as a clinical assistant, and research work. It may lead to a degree of Master of Science in Ophthalmology, or Doctor of Science in Ophthalmology. The whole course is designed to fit men for the special practice or teaching of ophthalmology.

CHICAGO.

The transitional conditions that mark graduate teaching of ophthalmology thruout the United States are especially noticeable in Chicago, where the Chicago Post-graduate School, the Polyclinic, and the Eye, Ear, Nose and Throat College, are all still on the old familiar basis of clinical and fragmentary teaching. To the Illinois Eye and Ear Infirmary may be applied what has been said above about the Wills Eye Hospital of Philadelphia, except that the function of giving instruction to the profession is not so well recognized as essential, in the Chicago institution.

Recently there has been a movement to unite the above institutions by some agreement that would coordinate their activities, and might give opportunities for the economic use of the student's time, unsurpassed anywhere. But this movement has been delayed or suspended, at the instance of those who are planning departments of graduate teaching in connection with the Universities, the medical departments of which are looking forward to reorganization, and may in a few years offer large opportunities for graduate teaching.

ST. LOUIS.

In the Washington University a special course has been arranged to meet the needs of students from the Medical Department of the U. S. Navy. This has been given in conjunction with training in other branches. The work in Oph-

thalmology occupies 3 days a week for 13 weeks, a total of 255 hours. Of this time one hour has been given to the anatomy of the eye and orbit, one to history taking and literature, 2 to physiologic optics, and 10 to histology, pathology and bacteriology. The remainder of the time is devoted to methods of examination and diagnosis, and practical clinical work. This constitutes an eminently "practical" or clinical course, covering much the same ground as was occupied by the older courses; but improved in that it has been made more definite and systematic.

SAN FRANCISCO.

The San Francisco Polyclinic is now connected with Leland Stanford, Jr., University. During the war its activities were partly in abeyance; but it is now becoming more active again, although practically along old lines. It has a small, fairly equipped eye department; that, with its university connection, should enable it to give a complete course in ophthalmology to a limited number of students. An increase in its corps of instructors will be necessary to enable it to utilize the whole of the student's time to good advantage. But it will be possible to establish here an institution for giving good ophthalmic training to small classes; that is much needed on the Pacific Coast.

NEW ORLEANS.

Something is being done to teach ophthalmology in New Orleans along the old lines of graduate teaching; and the training of clinic assistants offers what has heretofore been the best training obtainable in most American cities. But the Eye, Ear, Nose and Throat Hospital, the eye department of Tulane University, and of the Turo-Infirmiry are themselves in transitional conditions; and planning for the future rather than offering the greatest facilities of which they are capable at present.

OTHER CITIES.

In a number of other cities, as Baltimore, St. Louis, Cleveland, Cincinnati, etc., there are possibilities for graduate teaching of ophthalmology that could be

speedily and rather easily developed; but no movement to bring this about in the near future is apparent, and no general opportunities are now offered to those seeking ophthalmic training.

UNIVERSITY FELLOWSHIPS.

The school of serving as clinical assistant is open to a limited number in all ophthalmic clinics. But in three of our strong universities this has been developed to a more systematic and effective plan of training.

At the University of Michigan at Ann Arbor, a small number of students are taken on a "Fellowship" basis. They assist in the clinical work, in positions of successively increasing responsibility. They receive systematic instruction, and later have the educational advantage of instructing their successors. Thus in two or three years of full time continuous work an almost ideal training in ophthalmology may be obtained by the few who can avail themselves of such opportunities. Something of the same kind, although less completely developed, is being done at the University of Iowa, in Iowa City. But the most complete working out of this plan of instruction is seen at the University of Minnesota, at Minneapolis and at the Mayo Foundation at Rochester, Minnesota.

At Minneapolis there are 5, and at Rochester 4, Fellowships in Ophthalmology and in Oto-Laryngology. During the first year the time of the student is devoted largely to the fundamentals. An average of 300 hours is given to special anatomy, histology and embryology; and 100 hours to physiology of special senses and physiologic optics. Special pathology 24 hours, is also given during the first year; and special courses of 4 to 12 weeks each cover the field of ophthalmology. On completion of the course on physiologic optics and the didactic course in refraction, the student spends an average of 6 hours a week, throughout his course, in the refraction clinic.

During the second and third years, the student devotes his time largely to clinical work and his thesis work, serving as a teaching assistant in the out-patient clinics, and as special interne in the hospital. The duration of the course is two

or three years leading to the Master's or Doctor's degree respectively.

The Fellowships, both at Rochester and the University carry a stipend of from \$600.00 to \$1,000.00 per year. The University is also preparing to establish a one year course to consist chiefly of advanced work in the fundamentals.

A SUMMER COURSE.

The University of Colorado offers a summer course designed to ground those who take it in the fundamentals of ophthalmology; and to prepare them to profit by the clinical opportunities afforded by graduate schools that do chiefly clinical teaching, or by service as assistant in an ophthalmic clinic or practice. This

course has heretofore covered 6 weeks, increased until now it occupies 12 weeks. The whole day is given to the study of ophthalmology. Students who have had the required preliminary training in mathematics and physics, and a year of internship in a general hospital, or its equivalent, may, after completing this course and passing the required examination, become candidates for the degree, Doctor of Ophthalmology. These are required to devote an additional year to the study of ophthalmology and to prepare and defend a thesis embodying original research. This year may be taken at the University of Colorado or elsewhere.

EDWARD JACKSON,
WALTER B. LANCASTER.

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JEAN MATTESON, Room 1209, 7 West Madison Street, Chicago, Ill.

THE CLASSIFICATION OF CATARACTS.

Our knowledge of the pathology and etiology of senile cataract is so limited and incomplete, that it is no wonder our ideas are still unsettled on many points, and contradictory statements and terms are accepted and go unnoticed.

Altho Becker's researches more than 30 years ago had shown that the nucleus itself never, or at least very seldom, becomes cataractous, there is not in general a clear understanding about the respective roles played by the nucleus and the cortex, in the development and ultimate outcome of the opacity. Many a student, witnessing a cataract operation, considers the large yellowish translucent nucleus as the cataract itself; not realizing that the soft white lens matter coming out with, or after the nucleus, and scarcely noticeable for him, constitutes in reality the opacity of the lens.

The nucleus undergoes with advancing age a physiologic process of sclerosis beginning in the center, the fibers being compressed and flattened by the apposition of new fibers in the periphery.

These fibers can not be cast off as other epithelial structures placed on the surface of the body are; but remain in the center, and altho changing in color to a yellowish or brownish hue, do not lose transparency.

The process of degeneration which we call senile cataract, takes place only in the layers of cortex surrounding the nucleus; and in the beginning has two distinct clinical types; the opacity being formed either near the equator or directly forward or behind the nucleus in the area of the pupil. When the opacity begins in the equator it is called *cortical cataract*, and if initiated in the area of the pupil *nuclear cataract*.

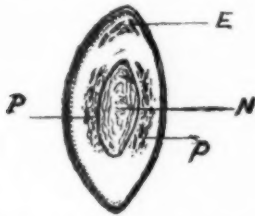
This classification, however, is radically wrong inasmuch as the nucleus itself not becoming opaque, there can not be a question of a nuclear cataract.

Furthermore, both types are really *cortical*, the only difference being in the starting point of the opacity. For that reason the term *cortical* ought to be dropped from our language, and the type of cataract beginning in the periphery—generally by opaque strokes or sectors—be called *equatorial cataract*.

The other form appearing in the center of the pupil as a light haze or cloudy white spots, and due to the opacity of the layers in front and especially behind the nucleus, ought to be called *paranuclear cataract*, that is, near the nucleus.

Other designations, for example, "perinuclear," will not be accurate, as the cloudiness does not surround, in the beginning, the nucleus; and, moreover, this term has been already applied to zonular cataract. The name *supranuclear*, proposed by Bach, is also inaccurate.

Some authors call "subcapsular" all types of cataracts which are not in the



Schematic drawing representing the two types of senile cataract. N nucleus. E equatorial cataract. P perinuclear cataract.

capsule itself, and in this sense subcapsular or cortical have the same meaning. Bach, however, has applied subcapsular to the equatorial form, only increasing thereby the existing confusion in terminology. We must then separate two clinical forms in senile cataract, the equatorial and the paranuclear, both being cortical, both being subcapsular, and both outside and around the nucleus.

Some authors have described lately as an independent entity a smoky cloudiness appearing in the center of the pupil and disappearing gradually in the periphery, which they call "senile nuclear," and in which the nucleus itself may have undergone a process of opacification, but there is not yet sufficient pathologic data to substantiate this claim.

M. URIBE TRONCOSO.

THE DIFFERENTIAL DIAGNOSIS OF CONJUNCTIVAL FOLLICULOSIS AND TRACHOMA.

The age-old controversy over the diagnosis of conjunctival folliculosis and trachoma is again revived in a fervent article by Jervey of Greenville, S. C. This

article was read before the Section on Preventive Medicine and Public Health, of the A. M. A., at New Orleans, April, 1920, (Journ. A. M. A., Oct. 23, 1920) and was apparently acrimoniously discussed by some of the brightest minds of the profession. This was evidently instigated by the differences in opinion, necessarily those of diagnosis and treatment of the medical officers of the United States Public Health Service, in South Carolina, who are alleged to have made in one community a diagnosis of sixty-six (66) cases of positive trachoma, out of approximately 1,000 school children examined, forty (40) of these same children having been seen by the author and, in his opinion, none of them had trachoma, but did have conjunctival folliculosis.

Some years ago there was a furor in New York, Philadelphia and other Eastern Cities, which broke into the public press—headlined in heavy type—over the alleged prevalence of trachoma in school children and hundreds upon hundreds of these were subjected to the expression and other operations, with resultant alleged cure in most of them, within a few days. Many children were excluded from school under this suppositional diagnosis.

It is to be admitted that trachoma is endemic in certain parts of America, but it also must be acknowledged that conjunctival folliculosis is worldwide and is to be found in practically all children, especially in those who have enlarged tonsils and adenoids, for it is practically the same as adenoids of the conjunctiva, simply a hypertrophy of the conjunctival follicles, which gradually diminishes as the child grows older and which, in but few cases, gives rise to any symptoms.

Most cities, localities and even separate states of America, except for imported cases, are relatively free from true trachoma. Trachoma, too, is not a disease of children. It is seldom seen under puberty, even in families in which the adults are afflicted. When acute, it is a highly contagious disease and almost always several members of a family suffer together.

Therefore, we look askance upon such diagnoses as were apparently made in the survey of the school of Newberry, S. C., of sixty-six (66) cases of positive trachoma distributed among fifty-five (55) different families. We, too, who do not see many cases of trachoma and do see many of follicular disease, look with suspicion upon the authenticity of the diagnostic, trachomatous furor of several years ago, in the Eastern states. We are incredulous about the cure of trachoma within a few days or weeks, by one expression operation;—for we know that trachoma is an intractable affection; that a combination of both operative and medicinal treatment is necessary for months before a case can be stated to be cured. We know, too, that all cases of trachoma, no matter how light and no matter how treated, are always followed by cicatrices in the lids and that follicular conjunctivitis never has these accompaniments. There are a few cases that may be classed as "borderline," but in these the finding of trachomatous masses, so-called bodies, should establish the diagnosis. Microscopic section of these is readily made and the diagnosis instituted.

It would be witless, indeed, to wade through the vast literature on the subject. The writer, himself, remembers his own researches published in the *AMERICAN JOURNAL OF OPHTHALMOLOGY*, December, 1890, in which the jumble of ideas was sifted and, to his mind, a sharp differentiation then made between the true disease trachoma and the symptom folliculosis, which yet holds good, and this has been gone over and over again by others.

Had this dispute arisen over the diagnostic differences between vernal conjunctivitis and trachoma, perhaps it would be more readily understood; but even here the story is plain to the expert.

Far be it from us to detract from the very excellent results obtained in Kentucky and other places, by the examiners, lecturers and operators of the United States Public Health Service, especially those designated as trachoma experts. (*Journ. A. M. A.*, Oct. 23, 1920.)

However, where such a difference of opinion has arisen, as is evident in

the Southern states, it would be well for the authorities to have, for instance, examiners officially recognized by the Section on Ophthalmology of the American Medical Association, in order that certain localities be not stigmatized as the sites of malignant and dangerous forms of trachoma, and that our school children with folliculosis be not excluded from the public schools and subjected to operative treatment which, even in folliculosis, will certainly leave scarred lids and a certain amount of disability. Certainly no folliculosis cases, even of the follicular type of trachoma, should be subjected to operation before lighter measures are used, under influence of which the larger number will speedily lose their objective symptoms and the subjective, if any, be remedied.

H. V. W.

THE INTERNATIONAL OPHTHALMOLOGICAL CONGRESS.

The committee in charge of the organization of this gathering met in Kansas City, in connection with the meeting of the American Academy of Ophthalmology and Oto-Laryngology, October 15. With the adoption of the report made from it to the Academy, all of the national organizations of ophthalmologists have given their approval to its work; and the profession of America is squarely behind the enterprise. This means America in the broad sense, for both Canada and Spanish America have been represented upon the committee from the first.

The date has been set for opening the Congress in Washington on Tuesday, April 18, 1922. Authority has been given to shift this date slightly in case better provision can be made for the Congress by so doing, or it will better fit in with the national gatherings of the American Medical Association and the Triennial Congress of Physicians and Surgeons to be held in the spring of that year. But careful inquiry seems to show that the largest proportion of our visitors from Europe can come most conveniently during the Easter vacation and that year Easter Sunday falls on April 16.

The invitations to join and attend the Congress are now being sent out. They are addressed to National organizations of Ophthalmologists, and the Governments of Countries with which the United States has diplomatic relations. They will also be sent to individuals. The intention of the committee is to make the membership widely inclusive of members of the medical profession especially interested in ophthalmology; and some others working in optics and related branches of science. Those camp followers of medicine who seek connection with such an organization for advertising purposes will be excluded, so far as their character and purpose can be discovered.

It is likely that some who would be welcome to membership will not receive personal invitation to join. These should take the initiative, send in applications or get in correspondence with the Chairman of the committee on membership, Dr. Walter R. Parker of Detroit.

E. J.

WHICH LANDOLT?

The name of Landolt has been made most widely known among ophthalmologists by Edmund Landolt, who has worked in ophthalmology as practitioner, teacher and writer for many years in Paris. This is the Landolt of the Treatise on Refraction and Accommodation of the Eye, the broken ring test of vision, etc., etc. Of recent years, the younger member of the family, Marc Landolt, our collaborator in this JOURNAL, has worthily sustained the scientific position of the name.

Before the American troops went thru the Argonne region, there was in Strassburg a "Professor Doctor Landolt," who might have designated himself by the letter H., who wrote on the light sense in myopia, and the correction

of exophoria by wearing concave lenses (not needed for myopia).

For some years Dr. Edmund Landolt has urged in French, English and Spanish the improvement and accurate proportioning of surgical instruments. His annoyance is therefore excusable when a firm making surgical instruments in Freiburg, Germany, sends out in the lately "enemy countries" advertising matter stating that their instruments have the approval of "Professor Doctor Landolt." The original maker of the ophthalmologic reputation of the name naturally protests.

"No abbreviations," he desires. We confess to having offended in this. It has not always been easy in the past, sometimes not possible, thru the literature that came to us for review, to identify the Landolt to whom it should be credited. But we will try to do it henceforth. We have been able to discriminate between Priestley Smith, and Major Henry Smith and Homer Smith, and will try, with the help of editors of other journals, to do so among the Landolts. There have always been protests against confusion of authorship; and we have yet to hear of an author who liked it. That is the reason for attaching one's full name to a paper, and seeing (so far as that is humanly possible) that it is printed right.

E. J.

A CORRECTION.

On page 11 of our January issue the pictures for Fig. 9 and Fig. 10 are transposed, giving an impression the opposite of the truth regarding Case V of those reported by Dr. Sanford Withers. Eternal vigilance is a part of the price of a good journal. It is extremely easy for such an exchange of electrotypes to be overlooked by the printer until the page has been printed.

BOOK NOTICES.

History and Bibliography of Anatomic Illustration, by Ludwig Choulant. Translated and Edited by Mortimer Frank, B.S., M.D., Chicago. 463 pages and many illustrations. University of Chicago Press, Chicago.

In addition to a translator's preface and some interesting footnotes by Dr. Frank there is included an admirable memorial notice of him by Dr. Fielding H. Garrison.

Way back in 1852 there was published, at Leipzig, a monumental essay on *Anatomic Illustration*, by Choulant, who was Professor of Medicine in the University. The book has been out of print for many years; and we now owe to our former confrère, Dr. Mortimer Frank, of Chicago, a translation and reprint with the addition of more interesting material referring to the subject.

Choulant was a pedagogue of pedagogues. Reading the history of his life, shows that he was certainly one of the original conservatives and, tho he had a high position in the University, was rather an unpleasant personage. He was a lavish writer and apparently in all his writings, as well as in this book, he was great on German "gründlichkeit."

This work shows abstruse learning and an immense amount of investigation, dealing as it does, not only with purely medical illustration, but also with anatomic illustration having to do with art studies. Of these, of particular interest, are the sketches of Leonardo da Vinci, 1510 A. D., and Michelangelo, 1474-1564 A. D., whose drawings show result of actual dissection and are very complete. Of purely medical authors of the old days, the illustrations of Vesalius, 1543 A. D., are noteworthy for their accurate and clear drawing.

The grotesque character of earlier paintings and drawings of the anatomy of the human frame, is evident from the reproductions shown. Anatomic illustration has been considered from two viewpoints. 1. The aid rendered to anatomic science by the

graphic arts. 2. The aid rendered to the graphic arts by anatomic science. Pure anatomic drawing presents little of artistic anatomy, whereas artistic drawing is practically the idealized depiction of anatomic structures.

In the old days there were no means of reproduction and even when engraving on stone, wood and metals came into existence, the output of anatomic illustration was very little in comparison with what it is now, as photographic reproduction has largely and almost entirely taken the place of hand drawing. Even yet, however, the necessity for diagrammatic illustration exists and so for depiction of structures and organs that cannot be satisfactorily photographed; as yet obtains with illustrations relating to the fundus of the eye.

The work is freely and beautifully illustrated and printed. Our confrère, the translator, recently died and this work has been issued as a monument to his memory. The brief memorial notice of Dr. Frank which it contains is from the pen of Dr. Fielding H. Garrison of Washington, D. C.

H. V. W.

Aviation Medicine in the A. E. F., February, 1920. Prepared in the Office of the Director of Air Service. Document 1004; 322 pages, tables, charts and illustrations. Washington, Government Printing Office.

This is a Government publication of intense interest at this time, giving as it does the results achieved by the Medical Profession in the development and care of the military aviator; and is an exposition of the end results of the many thousands of examinations made by the special boards who examined candidates for aviation during the great war.

The work itself comes under three personal heads: 1. The selection of the flier. 2. The care of the flier. 3. Investigations relating to the flier. All of which are exhaustively entered into.

We, as ophthalmologists, are specially interested in the eyesight of the flier. Not only the medical men, but the fliers themselves, realize that of all

the physical attributes, vision is most important; and the eyes should be absolutely perfect in every particular to successfully do the work and withstand the strain to which they are subjected.

There is a difference between good eyesight and being able to see well. Every pilot must learn to see in the air, and his ability for "air sight" improves with practice.

Absolutely normal hearing is not essential to the flier, but it is better to be normal in order to hear the engine and the hum of the wires; and the first intelligence of the approaching enemy has often been thru the hearing of the machine gun fire, especially if the pilot's observation has been at fault.

The altitude to be achieved by each flier, his "ceiling," should be estimated in each case, for the thin air, cold and wind, and his reactions in certain cases obtund the sensibility, the eyesight, the hearing and mentality, so that otherwise good fliers should not, as a rule, go above the altitude in which they can keep on the qui vive.

In order to determine this, Major Schneider has exhaustively worked out the efficiency of men at various altitudes. Lt. Col. Henry Horn takes up the role of the labyrinth in flying efficiency, determining that a functioning labyrinth should be required of a pilot. But, as regards the tests, no set limits should be made on the symptom of nystagmus, as both the period of nystagmus and the past pointing, as well as the vertigo and the falling signs, derived during these tests, are diminished by practice in the air.

The *Eye in Aviation* is taken up by Col. Wilmer and Major Berens, not only from the medical aspect, but from the personal side of the aviator. It is necessary for the "Eye of the Army" to have good eyes himself, particularly sharpness of vision, good muscle balance and good color vision, not only in order to see the enemy, but to avoid the accidents of getting off and landing. In fact, of the fatalities in war, nine aviators were killed by accident to one by combat; and of these cases, it has been shown that a large portion

of the accidents were due to physical defects of the aviator, which might have been eliminated and were in a large measure in the last days of the war, by careful medical examination, supervision and instruction.

One of the particular present necessities, is the question of goggles for aviators, which may apply to many other vocations as well. For the flying man the goggles of the future should not limit the monocular and binocular visual fields. Where a tint is required, it should allow the maximum vision, be restful to the eye and not alter color tones seriously. Lenses of a yellow green tint are valuable.

Much is gone into as regards the causes of accidents and their prevention. It would seem that of all the allied fliers, the Americans were possibly the best taken care of. The English and French were forced to use men whose physical qualifications were not up to those of Americans. Yet many of them, owing to their opportunities, did more wonderful work than any of ours. The Italians, particularly, made good fliers, and were rigidly examined and properly taken care of.

The work was prepared under the direction of the Chief Surgeon, A. E. F., by Lt. Col. Wilmer, and is published from the Office of the Director of Air Service, for the information of all concerned.

H. V. W.

Festschrift Hermann Kuhnt zum 70 Geburtstag. Contributed by former students and friends. 708 pages, illustrated with 13 plates, and figures in the text. Berlin; S. Karger, 1920.

This tribute to Professor Kuhnt is all the more fitting in that it takes the form of volume 43 of the "*Zeitschrift für Augenheilkunde*" founded by Kuhnt and Michel 23 years ago, and ever since conducted by the man whose seventieth birthday it commemorates. It contains as a frontispiece a photographic portrait of Kuhnt; but beyond this and its title, no personal matter.

There are fifty-one scientific contributions from authors living in Germany and its recent allies, and a few

adjoining neutral countries. The first, by the veteran, Hirschberg, whose seventieth birthday was celebrated seven years ago, deals with the visual theories of the Greek philosophers and their relation to ophthalmology. The subjects of all these essays are given under the appropriate divisions of current literature; and later they will be noticed in the digest of the literature therein. The plates are chiefly photographic reproductions in black and white, with one in colors illustrating the subject of serous iritis and its relation to cyclitis and glaucoma. The paper and printing of this volume are well up to the standard of the *Zeitschrift* in former years.

The work of Kuhnt, aside from his establishing and editing of one of the most important German ophthalmic journals, has had a notable influence in various branches of ophthalmic surgery; as in the use of conjunctival flaps for wounds, the application of excision of the tarsus for trachoma, and the entrance of the needle for discission thru vascular tissue. He is worthy of this mark of respect on the part of his colleagues.

E. J.

Practical Medicine Series, Volume III, The Eye, Ear, Nose and Throat.
 Edited by Casey A. Wood, C.M., M.D., D.C.L.; Albert H. Andrews, M.D.; George E. Shambaugh, M.D.
 (See also p. 58.)

We welcome annually the arrival of this little volume, the epitome of the year's advances in the specialties of medicine relating to the head. Never does the book take in all the articles published, but selects a few of the most important; the abstracts being fairly extensive and thus more illuminating than those found under the same headings in the journals.

The book has a frontispiece in colors, a reproduction from our *JOURNAL* of some of the reviewer's painting of the fundus, on Neuroretinitis Syphilitica. This being reproduced by the 3-color process has thus lost much of the effect of the original drawings and is

nowhere near as good as the 4-color plates used in our *JOURNAL*.

The article itself is quoted in extenso, as are several others; notably those by Paterson and Fraser, on Intranasal Dacryocystostomy, where this operation is most highly commended. And yet others, as A. K. Wilson and W. C. Posey, frankly prefer excision of the sac for chronic dacryocystitis, as does the reviewer.

The abstract of T. Harrison Butler's article on Experiences and Statistics of the Cataract Operation, is a clear exposition showing 93.5 per cent of immediate successes, with failure in 6.5 per cent; 5.5 per cent of vitreous loss in English cases, 17 per cent in Palestine cases; 10 per cent of iridocyclitis in England, with absolutely none in Palestine; 10 diabetic cases, of which 4 were lost. In England, iridocyclitis was responsible for all the failures.

A. B. Middleton has found 28 cases of congenital condition of the fundus or bulb causing reduction of vision, in soldiers referred out of 200,000 troops. Weeks prefers the Lagrange operation in glaucoma. The editor of the work, Casey A. Wood, pithily remarks that every case of glaucoma is not best and most certainly relieved or cured by one particular method.

Military ophthalmology is extensively treated by Sleight and Haughey, after the methods of Lagrange. Some new drugs, as hypophysin and flavine, are described. Casey A. Wood has an abstract of his article on the Eye of the Burrowing Owl. More than usual space is given to refraction and the ocular muscles.

The Ear Department shows nothing particularly momentous, except the appeal of the ear surgeons (L. A. Dean) for better preparation of those going into the specialty. Page after page is given over to tonsils and adenoids, and "new" instruments have again been invented and described for this common and ordinary affection and operations therefor. The study of the book is well worth while.

H. V. W.

TWO GERMAN TEXT-BOOKS.

Lehrbuch und Atlas der Augenheilkunde. Dr. Theodor Axenfeld, Prof. in Freiburg. Sixth edition, 856 pages, 12 colored plates, 2 color prints and 636 figures in the text, many in colors. Jena, Gustav Fischer, 1920.

This book was written by Axenfeld and eleven of his colleagues; and must be regarded as the leading German treatise on ophthalmology. The introduction to Ocular Pathology and Therapeutics and the Examination of the Eyes are written by Axenfeld; so is the one on Diseases of the Conjunctiva. Ophthalmoscopic Differential Diagnosis is by Elschnig; and Function Testing by Heine. Bielschowsky treats of Disturbances of Motility and Anomalies of Position; and von Hippel of the Embryology and Congenital Anomalies, and Diseases of the Lids.

Stock wrote on the Lacrimal Apparatus; Elschnig on Diseases of the Cornea; Krückmann on the Uveal Tract, Vitreous and Sclera. The Diseases of the Lens are discussed by Bach; and those of the Retina, Optic Nerve and Visual Tracts by Greeff. Peters wrote on Intraocular Fluids and Glaucoma, and also on Diseases of the Orbit. War Wounds, Sympathetic Ophthalmia and Accidental Injuries are considered by Hertel; and Heine writes of General Diseases and their Eye Symptoms. The Ophthalmoscopic Plates come from the Atlas of Oeller.

The sixth edition contains somewhat more material than its predecessors. The additions are especially noticeable in the section on war wounds (15 pages), illustrated by cases drawn from the recent war. But the effects of irritating gases, as developed in that conflict, seem rather inadequately noticed, in the less than two pages given to them. Anomalies of refraction are not ignored in this treatise, but are considered with physiologic optics, visual acuity, perimetry, color and light sense, etc., in the eighty-five pages of the section headed Function Testing. Likewise, toxic amblyopias come in with the ocular symptoms of general dis-

eases. But in this last chapter some of the more recent additions to our knowledge of the subject are quite unnoticed.

The illustrations include diagrams, charts of visual fields, instruments and how to use them, photographs of patients, and microphotographs of normal and pathologic histology. Both external diseases of the eye and representations of the eye ground as well as bacteria of ophthalmic interest are shown in the color illustrations scattered thru the text. Of course, among such an extremely large number there are illustrations of widely varying excellence and value.

The Axenfeld book has the completeness which lavish illustration can give. It is well arranged and its subject matter well classified, and it has a good index. The irregular performance of multiple authorship is here reduced to a minimum.

Lehrbuch der Augenheilkunde. Dr. Paul Roemer, Prof. zu Griefswald. Third revised edition. 508 pages, 297 illustrations and 32 colored plates. Berlin and Vienna, Urban and Schwarzenberg, 1919.

Roemer originally dedicated his book to Paul Ehrlich; this edition is inscribed to his own students who fell in the war. It was first published to afford his students, in permanent form, his clinical lectures, which they might have as a personal souvenir. Its original form has been preserved, and in recognition of postwar conditions the work is restricted in size. Both in its excellences and its defects, it is marked by the characteristics of the clinical lecture, reproduced in book form.

The clinic case, the class room diagram, and the microscopic slide are replaced by illustrations. The appropriateness of these, their restriction to the teaching purpose and the excellence of their reproduction, constitute the most strikingly valuable feature of the work. Every picture introduced has a point to it, which is excellently brought out; and no more space is taken up with it than is necessary for this purpose. This commendation ap-

plies preeminently to the edition before us; and only partly to the English translation of the first edition, which had only two-thirds as many text illustrations and two-fifths as many colored plates.

The arrangement and proportioning of the matter is inferior to that of the Axenfeld book, altho in some points the arrangement is similar. Diseases of the conjunctiva and cornea are treated together, and the latter rather inadequately presented. Diseases of the iris (only the most important forms of iritis) have a separate section; and the lens, vitreous, optic nerve and retina are all considered, before we have the section referring to diseases of the choroid, eleven pages, of which half is devoted to sarcoma and three lines to tuberculosis. The ciliary body finds no place in the table of contents.

In this work also anomalies of refraction and accommodation are considered under "Function Testing;" in a section of fifty-six pages which also treats of focal illumination, diaphanos-

copy, ophthalmoscopy, perimetry, testing of light and color sense, and detection of simulation. On the other hand "Muscular Squint" has one section of twenty-six pages; and paralyses of the ocular muscles another section of thirty-three pages.

A feature that strikes one on looking into this book is the use of marginal headings. These are quite exceptional in medical books, and constitute a new departure of real value; utilizing the blank space which brings a disagreeable sense of waste to one who knows the present high cost of paper, and the difficulty of finding room for printed pages on his library shelves. On the margin of one page we have the guidance of: Keratitis Disciformis, Bandlike or Girdle Corneal Clouding, Drüsen Formation of Bowman's Membrane, and Calcification of Bowman's Membrane. We wonder when the agreements of printing houses and printers' unions in America will permit such marginal headings as a measure of efficiency and economy. E. J.

ABSTRACTS

Hartridge, H. *The Inversion of the Retinal Image.* The Journal of Physiology, Aug. 19, 1920, Proc. Physiol. Soc., May 15, 1920, p. 6-8.

In a recent paper Senet states that the retinal image is not inverted. The evidence on which the inversion of that image is based is absolutely reliable and may be briefly summarized as follows:

(1) If the eyeball of an albino animal be removed intact, and be mounted in a tube, so that while the rays from external objects enter the pupil, the posterior surface of the eyeball can be examined by an observer, then owing to the absence of pigment in the choroid the image formed on the retina is clearly visible. This image is seen to be inverted, top being at bottom and right being at left.

(2) In the case of an ordinary animal the choroid and sclera can with care be removed from the eyeball, leav-

ing the retina in situ, observation of the retinal image shows that it is inverted and transposed.

(3) Histologic examination shows that the exit of the optic nerve lies to the nasal side of the fovea. The blind spot thus produced is found by experiment to lie to the temporal side of the point of fixation. It can be proved that the blind spot does correspond to the papilla of the nerve, by an independent observer B directing a beam of light with an ophthalmoscope into the eye of an observer A. It is found that if B directs the beam onto the blind spot A only sees a faint diffuse glow, whereas if B directs the beam anywhere else A at once clearly sees it.

Further, if the angle subtended at the eye by the blind spot and the point of fixation be measured it is found to be equal to that of the fovea and the centre of the papilla of the optic nerve as measured from the posterior nodal

point. This would seem to give conclusive evidence that the retinal image is transposed in men, and therefore since the optical system of the eye is a symmetric one an inverted image also.

(4) Under certain pathologic conditions opacities formed in the eye media cast shadows on the retina. These are seen projected onto external objects and may be located by the perimeter or Bjerrum's curtain. It is thus found that opacities in one segment of the eyeball cause areas of blindness which occupy the opposite segment of the visual field.

(5) By applying a powerful light or sharply localized pressure to the exterior of the eyeball, as far from the summit of the cornea as possible, a glow is seen projected onto the images of external objects. This is found to occupy the opposite segment of the visual field to that in which the stimulus has been applied.

The above summarizes the evidence for the inversion of the retinal image and seems to me to be conclusive.

HENRY SEWALL.

Lafon, Ch. Nystagmus. *Ann. d'Ocul.* 1920, v. 157, p. 209.

The author discusses the question of nystagmus in a long article, with numerous case reports. Nystagmus is acquired or congenital. The former is accepted by all, but the latter is the object of discussion. It may be due to defect in vision, or to congenital lesions of various kinds. However, there are certainly cases where there is neither error of refraction nor congenital lesion, the loss of vision being due to the oscillations of the eye. Furthermore, similar congenital lesions are frequently not accompanied by nystagmus. These lesions and errors of refraction are predisposing rather than determining causes.

There are three forms: (1) permanent and regular, (2) irregular, (3) labyrinthine or cerebral. In (1) the oscillations are equal in the primary position and when looking up or down, but in the lateral position appear to have a slow and a quick phase. In (2)

the amplitude and the rhythm are unequal, at times modified by extensive, involuntary, more or less incoordinated movements. But there is no fundamental difference between (1) and (2). In (3) the movements are produced usually only in the lateral position of the eye, altho as in multiple sclerosis, a nystagmus may develop into a permanent one, resembling type (1).

Nystagmus is a static trouble of the eye. In looking to one side, for example, the appropriate contraction and relaxation of the muscles is performed correctly, but the static equilibrium cannot maintain the eyes in the new position. That is, there is a difference in the tone of the opposing muscles, which cause the oscillating movements. In permanent nystagmus, this is true also when the eyes are in the primary position.

Both movements are involuntary. It is not true that one is a voluntary one, attempting to correct the other.

Voluntary displacement of the eyes is governed by two functions, (1) direction and (2) convergence.

(1) Direction is subdivided into three functions: (a) laterality, (b) verticality, and (c) rotation, each being in relation with the corresponding semicircular canal and acting thru two pairs of antagonistic muscles. Nystagmus is a disturbance of one of these fundamental functions.

Convergence is always active, whatever the distance or position of the object observed may be, but its action is less in proportion to the distance of the object and the excentricity of its position. When the displacement of the eye is about 45 degrees, there is normally a slight homonymous diplopia, which can be elicited only in the dark room. In nystagmus, convergence is not affected. In fact, it even exerts an inhibitory action on the movements. It is observed, however, in patients who do not possess binocular vision.

It is wrong to identify the ocular motor functions with the conjugate movement dependent on them, for each of the former is composed of two fac-

tors; (a) a dynamic which directs the eyes toward the object, and (b) a static, which maintains them in the position of fixation. Nystagmus is a trouble of the static factor of one of the elementary functions of direction.

LATENT NYSTAGMUS. The author discusses the theories of various authors and describes a couple of his own cases. He considers this condition to be a congenital nystagmus, which is evoked by interference with convergence.

A continuous sequence of forms connects latent with permanent nystagmus. This is shown by several case reports, arriving at the form where covering of one eye causes increase in the movements. When the vision of the eyes is about equal, the increase is the same no matter which eye is closed. But the covering of an amblyopic eye causes an increase which is distinctly less marked than when the other is covered. The same accentuation of movements can be caused by the use of a strong convex lens, or of a prism, base horizontal. It is possible, also, by covering one eye, to convert certain forms of rotary nystagmus into the horizontal variety.

PERMANENT CONGENITAL NYSTAGMUS AND CONVERGENCE. In most cases, the oscillations increase, or even first appear, in forced lateral positions of the eyes. This is due to interference with convergence, as proven by the following reasons: (1) In most cases, where the vision of the eyes is unequal, the movements are greater and more irregular when the eyes are turned towards the side of the amblyopic eye. (2) The nystagmic movement caused by covering of one eye is less marked and sometimes fails to appear in the extreme lateral positions. (3) If the nose is prolonged by a screen placed in the sagittal plane, the nystagmus of the primary position is not modified but it is increased in the lateral position as soon as one of the optic axes is intercepted.

Convergence almost always diminishes nystagmus, sometimes abolishing it when the object is very close. The following facts are also to be noted:

(1) If a prism of 8 to 10 degrees base out is placed in front of each eye and the patient looks at a far object, the movements diminish or even cease, owing to contraction of the internal recti, as tho the object were very close.

(2) Often the decrease in movements is less or even nothing, if convergence is caused after an eye has been covered.

(3) After convergence has caused a decrease or disappearance of the nystagmus, if the object is brought closer, one of the eyes frequently makes a sudden movement of abduction, while the oscillations increase, altho the other eye continues to fix.

Decrease in nystagmus is most marked when the eyes are in the position of reading, due to the inhibitory action of convergence. This latter explains certain phenomena: (1) Many patients have vision of 1/5 to 1/10 for distance, altho they can read the finest type at 15 to 20 cm., errors of refraction having been corrected. (2) The necessity for having the object very close in order to secure good vision explains the early ocular fatigue of which the patients often complain. (3) Myopia is frequently present in nystagmus. It is not a cause, but an effect, due to the necessity of looking at an object close to the eye.

In rotary nystagmus, convergence may decrease the amplitude of the movements, but this is very rare. Fixation of an object, sometimes, not always, increases the movements. Some patients have immobile eyes when fixing, especially if the object is close.

From the above it is seen that convergence possesses an inhibitory action on congenital nystagmus. The greater the effort, the less the nystagmus, and conversely, anything weakening the convergence increases the nystagmus. The tendency towards convergence causes often a mild homonymous diplopia, which may even develop into strabismus.

Certain patients with nystagmus in the primary position can make it less pronounced by holding their eyes in a secondary position, e. g., turning the

eyes towards the right and the head towards the left.

C. L.

Tresling, J. H. Retinal Angiomatosis.

Klin. M. f. Augenh., v. 64, 1920, p. 306.

Tresling describes a family occurrence of retinal angiomatosis in two brothers, aged 29 and 25. The first patient stated that in 1916, he had V. = 6/6 in both eyes, but that the sight of his left eye failed a week ago. V. R. = 6/6, V. L. = 2/60. At the disc and the macular region small white foci, which within a month formed a large stellar figure, and recent hemorrhages. Upwards and downwards an artery with the accompanying vein grew large, became tortuous towards the periphery and merged into a red nodule. The lower nodule had twice the size of the disc, and the vessels showed distinctly thru, artery and vein connected by small vessels. With nodules projected from 8 to 9 D. showed no pulsation upon pressure, like the vessels. At the distal end small vessels emerged. Later on, a small artery

expanded and showed several nodular swellings.

The second patient also complained of impairment of sight of his former good left eye for a week. V. = 1/60. Slight opacity of the vitreous. The lower border of optic disc was indistinct and surrounded by a large white focus spreading into the nasal half of the retina. At the macula also white foci and above it a large greyish white area. Here an artery and vein with their branches were very tortuous, widened, and entered beyond the white area into a red well defined nodule, in which the vessels could be discerned.

While at the beginning the very marked changes of the retina suggested retinitis exudativa, the interior enlargement and tortuosity of the vessels decided the diagnosis of angiomatosis retinae.

Wassermann reaction and general examination of both patients, who stayed at the clinic for four weeks, were negative. On account of the family occurrence the affection may be congenital, as was surmised by others.

C. Z.

NEWS ITEMS

Personals and items of interest should be sent to Dr. Melville Black, 424 Metropolitan Building, Denver, Colorado. They should be sent in by the 25th of the month. The following gentlemen have consented to supply the news from their respective sections: Dr. Edmond E. Blaauw, Buffalo; Dr. H. Alexander Brown, San Francisco; Dr. V. A. Chapman, Milwaukee; Dr. Robert Fagin, Memphis; Dr. M. Feingold, New Orleans; Dr. Wm. F. Hardy, St. Louis; Dr. Geo. F. Keiper, LaFayette, Indiana; Dr. Geo. H. Kress, Los Angeles; Dr. W. H. Lowell, Boston; Dr. Pacheco Luna, Guatemala City, Central America; Dr. Wm. R. Murray, Minneapolis; Dr. G. Oram Ring, Philadelphia; Dr. Chas. P. Small, Chicago; Dr. John E. Virden, New York City; Dr. John O. McReynolds, Dallas, Texas; Dr. Edward F. Parker, Charleston, S. C.; Dr. Joseph C. McCool, Portland, Oregon; Dr. Richard C. Smith, Superior, Wis.; Dr. J. W. Kimberlin, Kansas City, Mo. Volunteers are needed in other localities.

DEATHS

Dr. Fontain Bruce Moore, Memphis, Tennessee, aged thirty-five, died at his home recently from pneumonia.

PERSONALS

Dr. Howard F. Hansell, of Philadelphia, spent the Thanksgiving holiday period at Detroit, Michigan.

Dr. Henry R. Lesser, of New York City, announces his removal from 35 West 114th street to 294 Central Park West.

Dr. L. Webster Fox, of Philadelphia, will spend his Christmas holiday vacation in a trip to Porto Rica.

Dr. Eugene M. Blake, of New Haven, has been appointed Assistant Clinical Professor

of Ophthalmology at the School of Medicine, Yale University.

Dr. William Hislop Manson has been appointed to the chair of Ophthalmic Medicine and Surgery in Anderson College.

Drs. T. C. Lyster, E. R. Lewis and I. H. Jones announce offices at 1920 Orange street, near Westlake, Los Angeles.

Dr. Blanche Norton has been awarded the Cross of King George I, in recognition of her work among trachoma victims in Greece.

Dr. George E. de Schweinitz and Dr. Thomas B. Holloway spent a brief holiday at Virginia Hot Springs over the Thanksgiving vacation period.

Dr. P. B. Wing, formerly of Tacoma, Washington, announces that he has opened an office in the Watts Bldg., San Diego, California.

SOCIETIES

The Chicago Ophthalmological Society held a joint meeting with the Chicago Neurological Society, on December 16th, which brought out interesting papers and discussions on the action of the pupil in various diseased conditions of the nervous system.

Doctor H. F. Hansell, of Philadelphia, read a paper before the Ophthalmic Section of the College of Physicians at its December meeting upon "The Ophthalmic Symptoms in a Case of Obscure Brain Disease," which was prepared for the last meeting of the American Ophthalmological Society, but which his trip to Europe prevented him from presenting.

Dr. George E. de Schweinitz, of Philadelphia, read a paper before the Section of Ophthalmology of New York Academy of Medicine on Monday evening, December 20th, concerning "Ocular Conditions in Pituitary Body Disease in Syphilitic Subjects with Illustrative Cases." The discussion was opened by Dr. Frazier of Philadelphia—Surgeon; Dr. Weeks—Ophthalmology; Dr. Dana—Neurology.

The Ophthalmic Section of the College of Physicians of Philadelphia held a joint session with the Sections of Rhinology and Laryngology on Thursday evening, November 18th. Dr. J. Parsons Schaeffer, Professor of Anatomy at Jefferson College, gave a lantern demonstration accompanied by an exhibition of a series of superb specimens illustrating the association of the "Optic Nerve and the Optic Commissure to the Paranasal Sinuses." The discussion was opened by Dr. James Bordley, Jr., of Baltimore and Dr. William Campbell Posey of Philadelphia, from the viewpoint of Ophthalmology, and by Dr. Chares P. Grayson and Dr. George Fetterolf of the University of Pennsylvania, from that of Rhinology. The chairman of the section, Dr. G. Oram Ring, gave a dinner to Dr. Schaeffer and the participants in the discussion at the Union League preceding the Section meeting.

At the recent meeting of the Medical Society of Virginia, a number of eye, ear, and throat specialists, realizing the need of an active organization in the state for the scientific study of the problems of ophthal-

mology and oto-laryngology, formally organized the Virginia Society of Oto-Laryngology and Ophthalmology. The following officers were elected for the first year: Dr. Hunter H. McGuire, Winchester, president; Dr. W. F. Mercer, Richmond, vice-president, and Dr. C. S. Dodd, Petersburg, secretary-treasurer. The first meeting of the Society will be held at The Jefferson Hotel, Richmond, Va., on February 3, 1921. In addition to a number of papers which will be presented by members of the Society throughout the state, there will be a symposium on Simple Glaucoma. Several invited guests of national reputation have been asked to deliver addresses on the various phases of ophthalmology and oto-laryngology. The new Society will, probably, meet semi-annually.

MISCELLANEOUS

A government bill in England, which went into effect in September, provides that every blind person who has attained the age of fifty shall be entitled to such pension as, under the Old Age Pensions Act, 1908 to 1919, he would be entitled to if he had reached the age of seventy.

Patrick H. Vaughn of Harrisburg, Pennsylvania, was known as the "model landlord." He refused to raise rents of his numerous properties during the war. In his will, probated in November, ten of his houses are set aside, in which the families of worthy blind are to be permitted to live rent free.

The President of the Moorfields Eye Hospital of London has issued an appeal for a fund of 100,000 pounds: (1) To pay off a heavy debt. (2) To enable it to extend its laboratory accommodations for purposes of clinical and pathologic research. (3) To supply adequately paid assistants to the Honorary Medical Staff, which will liberate them from much routine work which they now have to perform. (4) To supply adequate accommodation for the nursing staff.

The Chicago Lighthouse is an Industrial Training School for the Sightless, which is conducted by the Improvement Association for the Blind. It is not conducted for profit, but is a great humanitarian undertaking dependent upon the public for its support. At a recent meeting of the Board of Managers, it was voted to have a series of card parties for the benefit of the blind of the Lighthouse. One of this series was given on December 16. The prizes were all donated by prominent local shop owners, and about \$250.00 was realized.